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HIGH TECHNOLOGY AND REGIONAL DEVELOPMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON TRADE, PRODUCTIVITY, AND ECONOMIC GROWTH

OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

NINETY-SEVENTH CONGRESS

SECOND SESSION

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CONTENTS

WITNESSES AND STATEMENTS

MONDAY, MARCH 1, 1982

	Page
Brown, Hon. Clarence J., vice chairman of the Subcommittee on Trade, Productivity, and Economic Growth: Opening statement	1
McSwiney, James W., chairman of the board, Mead Corp	2
Heine, Tom, president, Dayton Area Chamber of Commerce	5
Krug, Maurice F., president, Technology, Inc., Beaver Creek, Ohio	11
Huntington, Jeffrey, research manager, Yellow Springs Instrument Co., Yellow Springs, Ohio	15
Kegerreis, Robert J., president, Wright State University, Dayton, Ohio	24
Fitz, Brother Raymond L., S. M., Ph.D., president, University of Dayton	27
Elfner, Lynn E., executive officer, the Ohio Academy of Science	30
Peterson, George P., Director, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Command	50
Prather, James G., Deputy for Science and Technology, Office of the Assistant Secretary of the Army (Research, Development, and Acquisition)	51
Kerr, Robert, chairman, Winters National Bank	62

SUBMISSIONS FOR THE RECORD

MONDAY, MARCH 1, 1982

Elfner, Lynn E.:	
Itinerary of the 91st annual meeting of the Ohio Academy of Science, April 23-25, 1982, hosted by the Ohio State University	35
Written testimony to the Ohio Department of Education concerning State standards for Ohio schools—presented on behalf of the Ohio Academy of Science	37
Heine, Tom:	
A list of completed studies that is available on high technology in the Dayton, Ohio, area	10
Table reflecting scientists and engineers in the Dayton, Ohio, area, 1981	10
Prather, James G.: Prepared statement	54

HIGH TECHNOLOGY AND REGIONAL DEVELOPMENT

MONDAY, MARCH 1, 1982

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON TRADE, PRODUCTIVITY,
AND ECONOMIC GROWTH
OF THE JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., the Kettering Center, Dayton, Ohio, Hon. Clarence J. Brown (vice chairman of the subcommittee) presiding.

Present: Representative Brown.

Also present: Mark R. Policinski and Robert Premus, professional staff members.

OPENING STATEMENT OF REPRESENTATIVE BROWN, VICE CHAIRMAN

Representative BROWN. The focus of this hearing is the recent growth of high technology industries in the Dayton area economy, what has been done to foster this growth and how Dayton is using its emerging technology base to revive its local economy.

This growth in high technology industries is valuable to all communities, but it is particularly necessary for regions of the country that have experienced economic decline over the past decade. These new high technology jobs are aimed at the future and provide the infusion of new ideas, new capital, new skills, and new growth in communities that have borne the brunt of this Nation's economic misfortune.

The rise of high technology industries does not threaten existing jobs or companies. In fact, because of the explosion of technical knowledge in the world, all industry whether old or new depends to an increasing degree on science and technology for survival and growth.

The high technology jobs of today are not a replacement of present jobs, but augment and secure jobs already in the community. The days of fear of science and technology must end and we must enter a new day where we use science and technology to improve our futures.

Science and technology development often begins in a remote university or government research laboratory far removed from everyday life. It ultimately finds its way into our lives in the form of new and improved products and production methods. The journey from the research laboratory to the marketplace is long and uncertain. Finding ways to speed up the transfer of technology from laboratories to the home or workplace can do much to reverse our productivity decline

and restore American industry to its competitive position in the world economy.

This hearing will concentrate on this transfer of technology with particular interest in ways to strengthen linkages between Dayton's science-based industries and the region's university system. Also, ways to strengthen linkages between Dayton's scientific community and the military R. & D. market will be discussed. How new science-based companies spin off from R. & D. efforts on advanced weapons systems and space technology will be explored. Finally, the question of venture capital will be addressed. Forming new science-based companies offers a great opportunity to modernize the industrial structure of a region, but it also creates some risk for financiers. Ways to address the problem of capital shortage for new companies will be explored.

This hearing emerges out of a strong belief that I have had for many years that this region, like other regions throughout the manufacturing belt, possesses the educational, cultural, and scientific resources to command a leadership role in the high technology industries in the 1980's and beyond. To the extent that this hearing is successful in providing a greater public understanding of the complex issue of technology transfer and the linkage between technology development and growth, it will have served a high purpose for the subcommittee, the Congress, and the country. Thank you.

Our first witness this morning will be Mr. James McSwiney of the Mead Corp. Mr. McSwiney, please proceed.

STATEMENT OF JAMES W. McSWINEY, CHAIRMAN OF THE BOARD, MEAD CORP.

Mr. McSWINEY. Good morning. I am James McSwiney, chairman of the board of the Mead Corp. Mead is a diversified forest products company with sales of $2.9 billion in 1981, employing more than 25,000 people worldwide. Mead has businesses in distribution, industrial products, and advanced digital technology.

I welcome the opportunity to address the members of the Subcommittee on Trade, Productivity, and Economic Growth of the Joint Economic Committee on some developments in the area of high technology by our company and also a bit about an important community project, the Miami Valley Research Institute, conceived to stimulate economic development and to insure that Dayton is a participant in the emerging digital world of tomorrow.

Over the last decade, Mead has built a new series of businesses based on applications of digital technology in the fields of information storage, retrieval, and reproduction. This may seem quite a departure for a forest products-based company, but we recognized years ago that our forest products operations would be greatly impacted by the way in which data was stored and retrieved—and we believe we had some expertise to bring to the process.

We now have four businesses all developed in-house, in this general area: (1) The leading electronic legal and news research service in the country; (2) a revolutionary new method of printing variable information by means of digitally controlled ink droplets; (3) new approaches to reprographics, using ink-jet technology; and (4) the use

of the computer to refine and speed up elaborate chemical analyses for both private and public organizations—a response to environmental needs.

These new businesses generated approximately $70 million in sales last year and employ some 1,250 people, about half of whom are in the Dayton area. We are also continuing to invest millions of dollars on research and development in these units, and we believe they will grow in a very significant way in the years ahead.

These businesses can trace an important part of their roots to a time when a small but highly innovative Dayton company joined Mead. The company, Data Corp., was started by two experts in optics and computer systems, and they had been doing pioneering work in computer recognition of aircraft. During the same period, the mid-1960's, Mead's research staff in Chillicothe, Ohio, had begun to examine the theoretical principles of ink-jet technology.

Data Corp. was a company with an important technology but with limited resources. Mead could provide those resources and Data Corp. was merged with Mead in 1968.

This little bit of history I've described has had some profound effects—all of them positive. From Mead's standpoint, we have greatly expanded the horizons of our company. Dayton is a community in the midst of transition from a manufacturing to a service economy. We are gaining valuable jobs and a continuation of the tradition of this valley as a center of invention. And as Dayton gains, so does the Nation.

As Daytonians, we are proud of our community's heritage of inventive genius. It was in Dayton that Orville and Wilbur Wright perfected the airplane. Today, Wright Patterson near Dayton is the center of research and design for the Air Force where more than 25,000 people, military and civilian, carry on the Wrights' early concept. Charles Kettering and Col. Edward Deeds created the automobile's self-starter, its ignition and lighting systems here in Dayton, and as a result, Dayton is a major automotive manufacturing center.

Mead's developments in high technology and those of many other local firms indicate that the special combination of advantages that fostered the heritage of inventiveness is still present in Dayton. The presence of Wright Patterson Air Force Base and the Air Force Institute of Technology; a strong group of public and private colleges and universities committed to teaching and research; a healthy entrepreneurial spirit where small businesses are willing to fashion a good idea into reality; and a strategic location within 90 minutes' flying time of two-thirds of the Nation's population—make this valley an exciting area.

With these ingredients, it's not hard to understand why a group of local leaders from education, government, and business, have combined their efforts so as to embark upon the Miami Valley Research Institute, a project which we feel will enable Dayton to truly compete and contribute to our Nation's technological development.

Last spring, representatives of the University of Dayton, Wright State University, Sinclair Community College, Central State University, and the Air Force Institute of Technology announced forma-

tion of the Miami Valley Research Institute and plans to create a high-technology research park in our area.

The threefold purpose of the Miami Valley Research Institute is: (1) to seek and carry out high technology research with the talent and facilities we presently have; (2) to recruit corporate and governmental research facilities for a 1,500-acre to 2,000-acre high technology research park; and (3) to facilitate the transfer of the basic and applied scientific and technical research to the production, manufacture, and marketing of new products and services.

Over a 2-year period, the faculty and staff of these institutions have identified eight scientific-technological research areas that represent the collective strengths of its member institutions. The eight areas are: (1) Computer and information science; (2) materials science; (3) biomedical and human factors engineering; (4) biomedical sciences; (5) environmental systems; (6) earth resources-energy utilization; (7) applied mathematics; and (8) aeronautical, astronautical, and allied sciences.

Currently, within these 8 areas, 175 professional research personnel from the University of Dayton, Wright State University, and the Air Force Institute of Technology are pursuing 375 different basic and applied research projects.

We should note that nationally, successful research parks are in close proximity to a distinguished group of higher educational institutions such as our own because these institutions provide access to a large pool of skilled researchers and technicians. At the MVRI member institutions, researchers, technologists, and technicians number nearly 6,000. One-fourth are scientists, another fourth are engineers, and half are technical and support personnel. That's more scientific and engineering talent per capita than most any other region in the country.

In addition to these important factors, Dayton has the kind of community life needed to support a research park. Property, building costs, and housing are favorable especially when compared to other areas supporting such research parks and Dayton's cultural amenities are outstanding for a city its size. We feel these factors will enhance our efforts to recruit corporate research facilities and the professional people who will staff them.

Perhaps the most important role for MVRI is in transfering basic and applied research from the laboratory to the production floor, which should mean more businesses and more jobs for Dayton over the long run. MVRI will also serve to strengthen the linkages among the science-based businesses, the universities, and the military community.

Others are also convinced that MVRI is more than a good idea. Last year, the Ohio General Assembly gave a 630-acre site in southeastern Montgomery County to the research park and approved an appropriation of $10 million with which to begin work on the park. The land is a rolling, wooded farmscape ready for a campus-like development. With the addition of some adjacent land, the park should in time grow to some 1,500 to 2,000 acres, thus providing for an appropriate size and setting for such research facilities. The park is strategically located near the interchange of I–675 now under construction, and with easy access to WPAFB, area universities, and Dayton's downtown.

There are several major research parks scattered around the Nation. Perhaps the three best known are North Carolina Research Triangle Park (where Mead has its CompuChem division); California's Silicon Valley; and the Route 128 complex in Massachusetts. It will be interesting and rewarding to look back in a decade to see Miami Valley Research Park among them.

But like the other research parks before it, MVRI will not grow and prosper without the partnership of business, education, and Government. Each of us in education, business, and public service, who is interested in the vitality of our region must ask what he or she can do to make this project and others like it succeed. We believe that most of the ingredients and the will to succeed are here—and with a little support such as that already evidenced by the State of Ohio—we can't miss. Thank you.

Representative BROWN. Thank you, Mr. McSwiney. Next we will hear from Mr. Tom Heine of the Dayton Area Chamber of Commerce.

STATEMENT OF TOM HEINE, PRESIDENT, DAYTON AREA CHAMBER OF COMMERCE

Mr. HEINE. Good morning, I am Tom Heine, president of the Dayton Area Chamber of Commerce, and I appreciate this opportunity to testify before the Subcommittee on Trade, Productivity, and Economic Growth of the Joint Economic Committee. On behalf of the business community, I welcome you to Dayton, Ohio. We believe that the development of high technology is vital to the economic growth and health of southwest Ohio. I'm sure you are aware that the Dayton area has a rich heritage of inventions and innovators. Our economic development efforts have been directed toward building on that heritage.

Today, however, I will not address our heritage; rather, I will be directing my remarks to: (1) Dayton's desirability as a high technology center; (2) attracting and retaining scientists and engineers; (3) the business community's commitment to the development of high technology companies; and (4) a specific recommendation for the creation of new jobs and dollars for the greater Dayton area through a technology transfer program.

DAYTON'S DESIRABILITY AS A HIGH TECHNOLOGY CENTER

Dayton's high technology story was detailed in the January 1981 issue of Scientific American, a leading science journal established in 1845 with a circulation of 705–124. The editors stressed the importance of Wright Patterson Air Force Base, highlighted the research and development of major corporations (NCR, Mead, General Motors, and Monsanto Research) and defined this community's broad technology base. (A reprint of that entire article is available.)

There are over 160 high technology firms in the Greater Dayton area, including electronic computers, electronic components, measurement instruments, aerospace and aviation research and development, and computer related service firms. These firms employ over 10,000 persons.

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Wright Patterson Air Force Base employs over 7,000 military and civilian scientists, engineers, and technical managers. That potent scientific climate and activities with avionics, aero propulsion, flight dynamics, materials aerospace medicine, and human factors are outstanding additions to Dayton's scientific and research community.

A number of studies have been conducted: (1) To determine what local firms think of this region as a place to do business; (2) to assess the region's asets; (3) to provide marketing support; and (4) to assist local firms with expansion plans. (Copies of these studies are available.) The following findings relate to Dayton's desirability as a high technology center.

STRATEGIC LOCATION

Dayton's location at the intersection of I–70 and I–75 is at the center of a major highway network, bringing 25 interstate and major State routes into swift access. Dayton is the 10th largest 90-minute market with a population in excess of 4 million within a 90-minute radius and the largest 90-minute air travel market which includes 69 percent of the Nation's population and 67 percent of the Nation's businesses.

TRANSPORTATION

Its unique geographic position, commercial and air freight facilities make Dayton one of the lowest transportation cost centers. A large amount of high technology products are shipped by air for high-speed transit. Emery Air Freight selected Dayton as its national hub; beginning service in November 1981, this has greatly increased this community's air freight capability.

SCIENTIFIC COMMUNITY

A large number of high technology firms have been established here by persons formerly employed at Wright Patterson Air Force Base, larger employers (NCR, Mead, GM) and local universities. Often their first contracts were with the base and then expanded to other markets.

ACADEMIC RESOURCES

Area colleges and universities have comprehensive science, engineering, and technological programs and qualified professionals working in research. One major component is the University of Dayton's Research Institute which ranks among the top twenty universities doing federally sponsored scientific and technological research. Wright State is well recognized nationally for its computer science program. Sinclair College just recently completed a multimillion-dollar technical training facility in response to the needs of the high technology tool and die industry.

LABOR FORCE

As previously mentioned the Greater Dayton area has more than 10,000 scientists and engineers working in the high technology field.

DIVERSITY

The industrial diversity of the area assures economic stability and continued growth for the region. The breakdown of employment is 27 percent in manufacturing; 20 percent in service; 20 percent in wholesale, retail trade; 13 percent in construction, finance, and real estate; and 20 percent in government.

OPERATING COSTS

In a cost analysis among Dayton and 14 other major high technology cities, Dayton ranked sixth lowest in electronic component cost, eighth lowest in measurement instrument cost, and fifth lowest in aviation research and development operating cost. More interesting than the rankings was the degree of the differences in cost among these cities. In most cases, the city having the lowest cost of operation was only 6 percent below Dayton's cost.

COST-OF-LIVING

Comparing the cost-of-living data prepared by the U.S. Department of Labor, only two of the cities compared had a lower living cost. Dayton ranks near the top in take-home pay after State and local taxes. And perhaps one of the most significant things, the average house cost in Dayton ($57,000) is the lowest among major metropolitan markets.

CULTURE AND RECREATION

Opera, ballet, symphony, art museum, 2,100 acres of parks, natural history museum, planetarium, golf courses, sports facilities, and professional football and basketball an hour's drive away help create a high quality of life.

ATTRACTING AND RETAINING SCIENTISTS AND ENGINEERS

With Dayton's good market location, scientific labor force, transportation and financing, it was not surprising to hear that 65 percent of the high technology firms surveyed in 1981 had plans to expand in the next 12 months. Like other regions of the country finding engineers was cited as the most difficult task. However, once scientists and engineers locate in Dayton, they tend to stay. The labor turnover rate among scientists and engineers is very low compared to other high technology centers around the country which average 25 percent or higher. Nearly 75 percent of surveyed firms indicated that their annual turnover rate was less than 5 percent. Perhaps the most important ingredient in our technology base is the large number of scientists and engineers per 10,000 persons of any major metropolitan area in the Midwest.

There are a number of reasons why scientists and engineers prefer the Dayton area, as evidenced by the low labor turnover rate. Of the aviation research and development firms, the firms that employ the largest proportion of engineers in their labor force, over 60 percent

indicated that they have no difficulty in attracting scientists or engineers.

Last fall, the Dayton Development Council, the industrial development arm of the chamber, surveyed over 1,000 local scientists and engineers to determine their likes and dislikes about the community. These persons were asked to rank the community in terms of the scientific environment, quality of life, and cost of living. The survey is currently being analyzed, and results will be forthcoming in May 1982. Initial analysis, however, indicated the following data.

In the local scientific community nearly 75 percent are engineers and 25 percent scientists. A further breakdown of the scientists and engineers is shown in table 1. Electrical engineers represent approximately 24 percent, mechanical engineers 13 percent, and computer scientists 12 percent. Computer scientist is one of the most difficult occupational categories to fill. This community has a relatively large number of these special people. This is no accident; we have excellent graduate and undergraduate computer science programs at Wright State University, University of Dayton, and Sinclair Community College.

The scientists and engineers gave high marks to our overall scientific environment. Forty-six percent indicated that they believed it was above average. They singled out: (a) challenge of work; (b) professional associations; and (c) university science and engineering undergraduate programs as the specific items receiving the highest marks.

The response to quality of life was separated into: (a) culture, (b) physical environment, (c) recreation, (d) education and environment for children, and (e) transportation. Receiving high rankings were culture—37 percent above average, recreation—36 percent above average, education and environment for children—51 percent above average, and transportation—44 percent above average. Our environment, including our weather, received a 29-percent above-average rating.

One of the most highly ranked factors was; place to raise a family. Engineers and scientists rank our community as an excellent place to raise children.

The above information just scratches the surface of what we will know and understand about the attitudes of our scientific community. When the analysis is complete, we will know: One, from what parts of the country they originate; two, how scientists and engineers from different parts of the country view our community; three, how they rank Dayton to the community in which they lived previously; and four, recommended policies for improving our overall scientific community.

THE LOCAL BUSINESS COMMITMENT

The business community for over 10 years has funded a nonprofit corporation, the Dayton Development Council, whose purpose has been to bring new jobs into this region. The development council is now a subsidiary of the Dayton Area Chamber of Commerce.

Currently we are working with the three colleges—Wright State, University of Dayton, and Sinclair College—to establish an incubator process. The incubator process, although not directed only toward high-technology firm development, could increase the number of suc-

cessful high-technology firms spinning off discoveries at Wright Patterson. The incubator process has five aspects: One, we are exploring a process for finding the inventions; two, we need a process for evaluating the technical and marketable aspects of the invention; three, we are seeking to develop a network of venture capital organizations; four, we are seeking a common site facility to house the program. In the case of high-technology firms, one possible site may be the new research park currently being established by the four local colleges. A successful incubator process, we are convinced, could improve the chances of inventions becoming new marketable products.

By way of example, I will cite one specific case of a high-technology firm which just 3 months ago received assistance to spin off from its parent research and development firm. The new firm is Digital Technology, a spinoff of Simulation Technology, Inc., a research and development firm. Simulation Technology, through a contract with Wright Patterson, developed two principal types of customized aircraft testing equipment. They included flight simulators and computer-language emulators. The founder and current president of Digital Technology saw the market potential of the computer-language emulator. He took what had been developed for the Air Force, modified it slightly, mass produced it, and sold it to the aircraft and aerospace industry. The computer-language emulators are used in laboratories to test aircraft subsystems. Digital Technology currently employs 10 persons, but expects to expand to 200 persons within 3 years.

The Dayton Development Council played an important role in finding the necessary financing for this new business. It is part of the expanding responsibility of the business community to help match high-technology startups with venture capital groups and local conventional financing.

RECOMMENDATION

Much of the area's high technology expansion has come about because of Wright Patterson Air Force Base. We can point to firms like Systems Research Laboratories, which began in the mid-50's with a few persons and has grown to employ over 1,200 persons. Systems Research Laboratories not only was a successful spinoff of Wright Patterson, but recently two new firms have been spun off from Systems Research.

Another high-technology firm that was spun off from the base is Universal Technology Corp. This firm was established in 1961 and now employs 50 persons. There are a number of firms in this area with similar beginnings. The chamber believes that this spin-out process from Wright Patterson could be increased through a cooperative effort and formalized process.

As an example, one specific research activity at the base on which we would like to place a greater degree of concentration is the Materials Laboratory. We support further expansion and development of this facility. We believe that in the future current metal and aluminum materials are going to be replaced by composite materials. These materials will include powder metals, graphite, fiber optics, and a host of new materials being developed at the Materials Laboratory.

The Dayton area as well as other metal-working regions of the country could benefit if the technology being developed here now were transferred to the private sector for immediate application. But we need to have a better understanding of what materials are currently being developed at the Materials Laboratory. And we need to begin to match that technology with metal working firms throughout the country which can integrate that technology into their manufacturing process.

The chamber and the business community would like to pursue this. We'd like to work with the Federal Government on a program to transfer technology being developed at Wright Patterson to the private sector. The Government operates on the leading edge of technology; it is creating the state of the art on a daily, changing basis. Transfer of new technologies to the private sector holds a relatively untapped potential for new job creation to aid the economy of the Dayton area.

A program developed here could be a prototype for other programs around the country. We are recommending that the U.S. Government help us develop a technology transfer program in Dayton.

If this idea of transferring material technology to the private sector is of interest, we would be happy to submit a joint proposal between our public and private sectors to demonstrate just how to do it.

Thank you.

[The list of studies and table referred to by Mr. Heine follows:]

NOTE.—The following studies have been completed and are available for your review:

(1) "Economic Analysis and Policies for Growth Electronic Components and Measurement Instruments, Dayton Area" (May 1981)

(2) "An Assessment of the Aviation Industry, Dayton Area" (May 1981)

(3) "Cost Analysis of the Electronic Component, Measurement Instrument and Aviation Research and Development Firms, Dayton and Selected High Technology Centers" (December 1981)

(4) "Discover the Dayton Difference for High Technology" (*Scientific American*, January 1981)

TABLE 1.—SCIENTISTS AND ENGINEERS IN THE DAYTON AREA, 1981[1]

Profession	Number	Percent
Aeronautical engineering	68	6.9
Biomedical engineering	2	.2
Chemical engineering	41	4.2
Civil engineering	48	4.9
Electrical engineering	234	23.8
Industrial engineering	16	1.6
Mechanical engineering	130	13.2
Nuclear engineering	5	.5
System	30	3.1
Biology	13	1.3
Chemistry	44	4.5
Computer science	114	11.6
Math	12	1.2
Metal	15	1.5
Physics	45	4.6
Statistics	2	.2
Other	149	15.2
No response	14	1.4
Total	982	100.0

[1] Source: Attitudes of Scientists and Engineers on the Dayton Area, Dayton Development Council Survey.

Representative BROWN. Thank you, Mr. Heine. Next we have Mr. Krug of Technology, Inc.

STATEMENT OF MAURICE F. KRUG, PRESIDENT, TECHNOLOGY, INC., BEAVER CREEK, OHIO

Mr. KRUG. Thank you, Congressman Brown.

First, let me say that I am honored to be asked to testify and I am pleased to fulfill Congressman Brown's request to appear. This area is fortunate to have a Representative of Congressman Brown's caliber. His understanding and appreciation of the process of job creation and productivity through private enterprise is second to none in the U.S. Congress.

Because one interest of the subcommittee is "what it takes to develop a successful science-based or high technology company," I think it would be beneficial to share my experiences in doing that.

I started Technology, Inc., in 1959, while in the employ of the University of Dayton Research Institute. I am a native Daytonian and have maintained my residence here all my life. I graduated in mechanical engineering at the University of Dayton in 1955 after having served 2 years during the Korean conflict. I worked part time for U.D.'s Research Institute for 2½ years while attending the university and became a full time professional engineer and manager after graduation. In order to strengthen my management capabilities I began part-time studies at Xavier University's Graduate School of Business. At that time, there were no graduate level studies being conducted in Dayton.

The late 1950's were an exciting time in our country and I was privileged to work on a range of important Government projects for the university. The very nature of a university allows an aggressive individual to become involved in a wide variety of research and development activities. One success leads to a second challenge, a second success lead to additional challenges.

By 1958, I felt that I wanted to become more involved in the development aspects of my work, especially the development of instrumentation for my research projects. At that time, the university did not have the capital resources to devote to such development and felt that this area was beyond their charter. As a result, I began to make plans to build my own company.

In June of 1959, Technology, Inc., was formed under the laws of the State of Ohio. I stayed on at the university for about 6 months as a consultant to assist the completion of the projects in which I was involved. Through my involvement with the development of the first physiological instrumentation package in the free world, the company's first project was a contract to support the aeromedical center at Wright Patterson Air Force Base. Soon came other projects in another area of interest for me, aircraft structural integrity.

It should be of interest to the subcommittee that, although our entry into business was sometimes in competition with the university, the ultimate result was the creation of more jobs and larger programs in these areas. In fact, within 3 years, there were more research programs

developed in our specialized areas than either the university or Technology could handle with ease.

Just as important as doing the work in which we were interested, was managing the company as a business. From the start, we put much emphasis on the financial and corporate structure in order to insure that we would remain a viable operation and could grow.

From that beginning, and $5,000 in startup capital—about one-third of it borrowed—Technology, Inc., has grown to a $50 million a year company with operations in Ohio, Michigan, Texas, and Tennessee. Our instruments and controls division here in Dayton has successfully completed more than 1,200 major contracts for such customers as the Air Force, Army, Navy, Coast Guard, FAA, EPA, NASA, NBS, and many large corporations including most major airframe manufacturers. The division specializes in test equipment, simulation, and training systems, information management systems, and a wide variety of special projects.

The life sciences division specializes in biotechnological support for Government and industry. With facilities in Washington, D.C., Houston, and San Antonio, Tex., the division provides bioengineering, bioresearch, human factors and instrumentation calibration and repair services that are widely recognized within the scientific community.

Our technology-scientific services subsidiary in Dayton is deeply involved in supplying personnel and expertise for a wide variety of Air Force and Government programs ranging from the fatigue testing of fighter aircraft canopies to the effects of lightning strikes on aircraft.

In Grand Haven, Mich., the industrial products division supplies industrial customers with precision metal forming. These fabricated and roll-formed products are supplied to customers in such industries as office equipment, solar collection, computer, and air pollution control.

The Dempster Systems subsidiary, located in Knoxville, Tenn., is an industry leader in solid-waste-handling equipment. It manufactures truck and trailer-mounted container handling units, self-loading compaction units, large volume stationary packers, transfer station packers, compaction and transport trailers, and related equipment.

You will note that the company has expanded far afield from its origins. The reason for this was a strategic decision in the midsixties not to be entirely dependent upon the Government for contracts. This does not imply that the Government is a poor customer. This move simply reflects our belief that no company should be too dependent upon a small number of customers. A company such as Technology, Inc., owes to its customers the sources and strengths that accrue through diversification.

Today, with 20–20 hindsight I may not have started Technology, Inc., in Dayton. I would go to Los Angeles, Boston, Houston, or one of the other major scientific centers where the customers and support services are in abundance. I know now that it would be easier to grow the company in these more enthusiastic environs. Also, startup capital is very difficult to locate in Dayton. As a member of the board of directors of Interstate Financial Corp.—of which Third National Bank is a part—I have seen first hand now a poor economy quickly dries up funds for even safe investments. The banking industry is encumbered

with many well-intentioned regulations which have limited its ability. When a community's basic financial institutions are thus hampered, it at least limits, and in many cases prohibits, that community from financing its own growth. That has happened in Dayton and the concensus places most of the blame on the Federal Government's fiscal policies. I agree and applaud the current administration's efforts to solve the problem even though it means short-term sacrifices.

Certainly, we would not have started in Dayton 22 years ago and would not be here today were it not for the Wright-Patterson complex. I am sure this is true of most, if not all, the high technology companies in the area. However, with the addition of graduate studies to an already fine curriculum at the University of Dayton and the establishment of Wright State University, the climate is improving.

It is absolutely vital for small, high-technology firms to depend upon these types of facilities. Without them, no Government or private program of any type will attract companies or encourage entrepreneurs here.

The role of the universities is particularly crucial in research. Most companies function in the area of applied research. It is not economically feasible to depend entirely upon pure research to survive. That is the function that universities perform best in the multidiscipline areas. There is no clearly defined separation between pure and applied research so, as a result, there will be times when private enterprise and universities will find themselves applying for the same programs. However, I believe that this competition is healthy for the competitors, beneficial to the customers, and will result in the long run in more work for both the profit-oriented and not-for-profit entities.

Government facilities such as Wright Patterson are needed because of the type of work they conduct and the size of these projects. We at Technology, Inc., have found that it is more cost effective for us to pursue a $500,000 contract with the Government than to try to obtain a commercial program that is more generally $40,000 to $50,000 in size.

I would like to see that situation change. The most important action that large, local companies could take in supporting the effort to attract high technology to the area would be to investigate what services they could obtain outside their own organizations. Very little is known in the business community about the specialized services available here. Part of the problem lies on our side of the fence in that high-technology firms could be doing more to sell services locally. A key factor in whether or not this occurs to any significant degree is the size of the projects large companies will buy outside.

There are two specific suggestions I have to make to this subcommittee on matters it can directly influence to reach the goal of encouraging additional high-technology firms in this area.

First, the awarding of contracts for research and services to the low bidder is fine in theory, but inflexibility in its application can create the opposite effect from what is intended. For example, if a particular research project has the potential of producing large equipment orders in future years, the large, prime Government contractors will bid at almost any price to get in on the ground floor. This research leads to applied research, then to development—the develop-

97-907 0 - 82 - 4

ment leads to preproduction contract awards, then to production follow-ons.

These may be huge compared to the original research and development programs and, by this stage, the Government is so wedded to the contractor that it is almost impossible to change.

By clearly separating the research and development phase, particularly the very early phases, the Government will be able to get more unbiased results and develop lower cost. Therefore, the research phase cost of a program may be insignificant in the total picture. This one approach, even on a limited basis, would create more local research and development programs because this is not an area where there are large air-frame and weapons systems manufacturers (who may, under this plan be barred from bidding). However, it may induce these types of manufacturers to locate here.

The second suggestion that would help the local area in the development of more firms and creation of more jobs would be to give an advantage to anyone located within 50 miles of the base for a particular procurement. This is done on occasion, but the technical people have a rather difficult time achieving this through procurement departments. Procurement cannot be blamed because the regulations are burdensome for them to justify this procedure.

But, there are economic justifications for taking this approach. For example, traveltime in the Government is rather critical and there are times when the travel budget is cut and the project engineers are not able to travel as much as they should to oversee the contracted work. In addition, the cost of managing a program at, say Los Angeles, is substantially larger for Wright Patterson than it would be managing the same program outside the gates of Wright Patterson Base, or within an hour's drive. The project engineer is able, with a program at Technology, Inc., to conveniently and economically review the project. Problems can be reviewed and solved quickly on a firsthand basis. There's a very strong case to be made for a step in procurement that considers the adverse effects of the additional costs involved in awarding programs outside the local area.

There is a need for improved cooperation between Wright State University Research Department, the University of Dayton Research Center and these emerging and established R. & D. firms in the Dayton area for all of them to achieve maximum growth and the creation of new jobs. These groups should begin to work together seeking ways of more efficiently supporting Government programs. The Government, universities, and industry individually have some functions they do better than the others. Perhaps we could identify better working methods which take these unique characteristics into consideration so that an improved working relationship among all three could be achieved. This would require a committee with respresentatives from all three groups which would study the proposal and develop guidelines for everyone to work with. Because the Government side of this triad is the most important element, it would be appropriate for it to take the lead in beginning such a project.

In summary, let me say that in our society, good companies are the result of good markets and good management. In the case of high-technology companies, they will continue to be born and will grow

in direct correlation to the amount of work there is available. If the Government and larger companies have the need for outside support, then universities, entrepreneurs, small and midsized companies will recognize these needs and meet them. I believe strongly that this subcommittee can serve best not by directly supporting or subsidizing small companies but by, first, speaking up in Congress for the free enterprise system, and second, by helping protect Government agencies and private enterprise from legislated impediments in efficient operation. More employment, more companies, and a better economy will soon follow.

I wholeheartedly support the goals of the subcommittee and pledge my help in its efforts. Thank you for inviting me to address you today.

Representative BROWN. Thank you, Mr. Krug. Mr. Huntington.

STATEMENT OF JEFFREY HUNTINGTON, RESEARCH MANAGER, YELLOW SPRINGS INSTRUMENT CO., YELLOW SPRINGS, OHIO

Mr. HUNTINGTON. I think some sort of angel is almost neecssary for a high-technology firm to get through those first few lean years. In Yellow Springs, the angel in the 1940's was Antioch College. Four of the largest nongovernment employers in Greene County are in Yellow Springs: Ray Thay, Morris Bean, Antioch Publishing, and the Yellow Springs Instrument, all of which were aided to some degree by Antioch College, who, for instance, provided low-rent accommodations to the Yellow Springs Instrument in the first 2 years of its operation before it retained its own real estate.

It's interesting to know that there are actually more numerous institutions of higher learning in Greene County than in Montgomery County, although the population center is, of course, Montgomery County. This may be an important factor. There is a critical mass phenomenon to high technology in general if you reach a certain level of activity in research and development and manufacturing of high technology. You tend to attract more people, more business and firms to do more of the same. And if you don't reach that critical mass you will probably erode what you have already. If you can convince the research companies to locate in Dayton instead of Washington, D.C., then the travel costs and hassle for people to leave their firms in Dayton to go elsewhere would be reversed. It would be people in the other parts of the country who would be inconvenienced and we who would be convenienced. This is an area in which many universities can support manufacturing in a nonobvious way.

Another way which tends to be forgotten is that high-technology firms need a lot of expertise which is not technical, or at least not scientific in engineering, maybe in business management, finance, quality control, and so forth. These are best, I think, provided through the universities. The largest firms have their own in-house programs to educate people while they work. It's difficult for a small firm, a fledgling firm to try to develop these skills which may take years of training in its own work force. Also, access to subprofessional skills is very important, welding, machinery, and the availability of components, electronics, glass work, that sort of thing, are absolutely vital.

I mean, if we take Leonardo da Vinci's invention of the helicopter in Renaissance Italy, with no aeronautic base of support for him, he did not develop the helicopter. The genius does not make a good product, certainly not by himself. He needs a large number of frequently small firms or at least local branches of large firms very close by, certainly no farther than Cincinnati or Columbus to make these ideas into practical reality. I think the Dayton area and the Springfield area as well have been very well blessed in their access to machinery support and drafting and blueprint skills and the other resources—well, subscientific support activities, electronic assembly and so forth that go into manufacturing. And I think that's an excellent reason for locating a high-technology manufacturing firm in the Dayton area.

I agree with most of what the preceding panelists have said, and I may echo them sometimes by accident. I would like to take exception to a couple of views I heard. One was that low cost-of-living is important in attracting scientists and engineers. My experience has been the contrary, that the public services and intellectual and artistic climate which a high tax base and well administered tax program can bring is probably a larger factor in attracting your honest workers than a low cost-of-living. Admittedly, a low cost-of-living is very valuable in retaining employees you have or who come from indigenous areas, and it certainly goes along with the high level of conservation support found in southwestern Ohio. Access to markets and communication is important. A misconception which I think I formed in my tender years, or something that was in the press a great deal about 20 years ago was that the world is shrinking so fast because of improvements in communication and transportation that geographic location would be immaterial shortly. And you could do research in Idaho and manufacturing in Ohio and your business management in Manhattan, and it would all be tied together somehow by satellite and computer, and everything would work very well. It doesn't seem to me that the world has shrunk as much as we were hoping it would back then. In fact, with the decreasing availability of petroleum products, it seems the world has maybe expanded a little bit in the past 10 years. It's enormously valuable to be able to drive over to Wright State University or Central State or the University of Dayton, or if you're a little more ambitious, it's probable to drive to the University of Cincinnati or to Ohio State University and talk to your colleagues, talk to your business professors, talk to a patent attorney and that sort of thing than it is to try to get in touch with somebody in New York City through a very unreliable phone connection or try to get a flight to Ames, Iowa, as I did recently. I spent a whole day at the airport watching one connection after another vaporize, and airlines change their schedules day to day, and airplanes were lost someplace. Finally, I made it on the second day. But, if the expert I was going to Iowa to visit had been in Dayton, it would have been a much more fruitful relationship.

If we can attract enough expertise in selected areas close to home, it will talk to itself, and communications will be vastly enhanced. I don't think that the printed scientific literature is really an adequate vehicle for conveying the depth of information that manufacturing firms need.

It's addressed to the editors of journals and grant officers, and it does not contain the type of information that a manufacturer needs.

That information, however, can be transmitted face to face if your communication and transportation system will permit you that sort of contact. It's not possible for a community the size of Dayton to have expertise in all areas at once. I don't even know whether the largest metropolitan areas could hope to do that.

I think the Dayton area will have to choose somewhat, as Mr. McSwiney and Mr. Heine have already indicated, which areas it wants to specialize in. Electronics is a natural. We would be competing with other areas in Ohio who are into glass and ceramics or rubber and plastics.

My own firm is very interested in biotechnology, and not in genetic engineering per se, but in support of that industry. And it's noteworthy to me that there is not much of that type of sophisticated activity going on in this area. We'll have to decide whether or not we're going to make a concentration in that or not.

Possibly the last and most intangible effect and the one which Mr. McSwiney testified to already, and that is the spirit of entrepreneurship, and Mr. Krug already mentioned that as well. I've lived in other areas of the country where business management was very, very clubby, and the attitude sort of retained that if the Lord had wanted you to run your own business you would have been born into a wealthy family.

I don't see that in the Dayton and Springfield areas. If you get a better mousetrap, you'll receive emotional and sometimes financial support from many quarters to open your own business and see what you can do. Let the marketplace judge whether you've got a good product or not, not family connections and old money, that sort of thing.

On the other hand, there's the economic indications that can go straight up and down. The regulatory atmosphere helps to translate that sort of thing. It's easy for a small thinly capitalized firm to lose its sense of direction, which would tend to propel it over the decades toward manufacturing. I think the Government can offer a gentle, and I hope not an intrusive but steady pressure in that area to create a climate in which manufacturing innovation, technical pioneering is favored. And I hope that activity is forthcoming from this hearing.

Thank you.

Representative BROWN. Gentlemen, thank you very much. As usual, I'm stimulated by a lot of questions, but I am restrained by time somewhat. However, we do have a few minutes for questions.

I found an interesting thread in the conversations we've had up to this point. The Special Studies on Economic Change by the Joint Economic Committee indicated that the future growth of the U.S. economy may relate more to the quality of life factors, such as cultural amenities, law crime rates, nice location, et cetera. However, both Mr. Huntington and Mr. Krug have suggested that location of technical R. & D. companies near the customer, whether Government or private, is still a pretty vital factor. This is true even though modern electronic communications and travel are so convenient and economical. Maybe that SSEC study was too premature. Or are we betting too early on location near the customer, the Wright Patterson Air Force Base or the technical community that is within the Ohio or Midwest area.

Mr. HUNTINGTON. I'll be glad to go first. The customer is certainly well situated if located within a half hour or 45-minute drive. It's more than really the customer, though. Most of the nonprofit, profit-making sector collaborations require a personal relationship. The collaboration on the oxygen electrode, the heart-lung machine, the Pumuster electric therometer and that sort of thing, we would not have those without the collaboration that was performed with the instigation of Mr. Leland C. Clark, who is a fellow at the institute of mental health in the new part of Wright State University in Yellow Springs. It was a very effective coordination between the two institutions only a mile apart. When Mr. Clark moved to Alabama, that contact and rapport were lost.

There are lots of other experts in the area, perhaps some better than he, but they weren't located close at hand. When Mr. Clark moved to Cincinnati, the collaboration resumed and the enzyme electrode line of products was the result. I don't think that collaboration with a colleague or an expert much farther away than Cincinnati is particularly practical.

Representative BROWN. Let me switch the question before I ask Mr. Krug and Mr. McSwiney to respond. I make reference in your statement, Mr. McSwiney, to the three best known research parks in the country, which are North Carolina's Research Triangle, with which I have some familiarity because of my education, California's Silicon Valley, and Route 128 Complex in Massachusetts, another one on which I have some background.

But, you mentioned that at the Research Triangle Park, Mead has its CompChem Division, and I wondered about the selection of that location, whether it related to a specialization of research that was available there, as much as Mr. Huntington has suggested where the principal minds in that field were located, or did it relate to some other factor within the Mead corporate strategy or your customers or market?

Mr. MCSWINEY. Well, generally speaking, the reason for going there was that there are a number of tool companies well known throughout the world and they located there, and there it's a little bit like keeping up with the Joneses. If you go there, you don't have to spend a lot of time and effort to get exposure. It's quick to find out what you can do and the quality of what you can do.

So, there I think it was more simply a factor of relating somewhat to what Mr. Huntington said. It was a proximity of sophisticated people in an area in which we were working.

Representative BROWN. And the area was?

Representative MCSWINEY. It's in the time and date and respect there to thermometers and computers. It's really tieing into the digital world with really everything that's going on with high technology, and it's nothing more than tieing together the software, or if we called it the digital world, with the kind of world that's always existed. We're simply manipulating and operating and making things we've done in the past work either more efficiently or more quickly.

Representative BROWN. But, this related to a product line that Mead was into or to a new raw research?

Mr. MCSWINEY. Well, it simply was concept. We've been in forest products, involved in the environmental area for a long while. We

know about the problems with toxicity and a whole host of those things. We also know the need when you're examining those changes is to get an answer quickly and to get good answers.

When you tie the digital growth and the specter of photography, you enhance that and also lower the cost.

Representative BROWN. The Research Triangle, did that grow out of the forest products specialization that already existed in that area or was it an accumulation? In other words, did they hire in the community or was the company involved in the community?

Mr. MCSWINEY. No. Most of the people left Dayton and went down and started it up.

Representative BROWN. Because of the facilities in the research park?

Mr. MCSWINEY. Yes.

Representative BROWN. Is it an objective of MVRI that that be the kind of magnet that would attract people from other parts of the country?

Mr. MCSWINEY. Well, the businesses I've been talking about can be seen as you drive along 75, you can see part of it as I mentioned now, Mead Digital Systems. And I mentioned earlier about half of those people are here in Dayton. We've got to make the decision, I guess, within the next 12 to 18 months as to where that's going to be. Half of it's in Dallas and half of it's here.

From my personal viewpoint, I'd like to see it all here. And amazingly, in the last year we did not find any real problem of attracting top-flight scientists here. I believe in Dayton we now have some 200 scientists that came from the most prestigious companies in America. And we find, generally speaking, that as Tom mentioned, it's a lot better to live in a community of 200,000, 300,000, get to the job in 10 or 15 minutes, some allusion about the impact of raising children, I don't know whether it's real or not, it's not as bad as it is somewhere else.

But, I don't think we have this problem. I think, as I'm sure you'll hear later today, the attitude existing between the educational institutions, I think there's an extremely good opportunity here as we move forward, but it's not all here today.

Representative BROWN. Mr. Krug, your comments indicated that your decisions were marginal about whether or not the company might have profited at some point from moving to Los Angeles or other centers where there are a lot more customers for work done by the company. Do you relate that to the growth of the company and its regional support in the research and technical area, or do you relate it to the attraction of being near the customer and the decision made, I guess, by the Federal Government to move certain research or product development items in the Defense Department to other parts of the country?

Mr. KRUG. Well, the answer to that, Mr. Congressman, is twofold. No. 1 is that in the 1960's, in the early 1960's, Technology spent hundreds of thousands of dollars bringing scientists and engineers into the community. Those people populated Mead and NCR and most of the bigger companies around here today. And we had at one time the second largest or third largest employer of scientific talent in the Dayton area.

There was a long period of time when there was little support in the community for us, and I think you have to recognize that there are two types of entrepreneurs. There's the type that develops the winches, and he makes that grow and figures out how to make a business out of it, and then there's the individual who is business oriented and aggressive and wants to build a business no matter what it is. goes up the ladder.

When I get back to the community support and so on. in 1961 Technology's business was about 60 percent aerospace medicine and about 40 percent structural integrity work for aircraft, and some other little things. But, they were important to us; they were our livelihood. And in kind of nosing around Washington I discovered that the Aerospace Medical Laboratory was going to be moved to San Antonio, Tex.

So, I immediately went to see our two fine Democratic Senators at that time. Young and Lausche, and told them what was going to happen. And they told me, no, that would never happen. I spent several visits going back and forth. I tried to get long-distance communication at that time, and no one thought that would happen. It was Wright Patterson from the inception and would not be moved. This was one of the raids on the Wright Patterson complex.

So, in frustration I said, well, OK, to the two Senators I said, "I'll tell you, we don't have a lot of employment. We're only talking about 50 people or 40 people or whatever it is right now, but when that operation moves to San Antonio, as it surely will, if you don't get off your seats our operation will move there."

The upshot of this is that in 1962, I went to San Antonio and moved our people down there. Today we have about 190 people in that area, and probably half have Ph. D.'s. It has a very high level of technical expertise. As you know, we have designed food for the astronauts, we have patents on freeze-dried green beans. We've done all kinds of little things.

And the climate, what I was speaking of, I'm a native Daytonian and I love this community, and, you know, it's been good to me, and I don't want to say anything adverse. I just want to make it better. The people there in the community, in the universities and so forth, kind of nurture this. They're really good to us, and they helped us and the town people were much more interested in us. And so, as a result, that grew faster than our division out here in Dayton.

The 1960's were a pretty competitive period also for companies in this area in the business we were involved in, and the budget relative to gross national product decreased substantially. We talk about whole dollars, and so on, and dollar figures, and the budget in defense and related expenditures have been decreasing rapidly. And Mr. Reagan and what he's talking about doing is not even bringing it to where it was when Mr. Kennedy was President.

So, we really need some understanding. So, for the person or the group of people who are developing a company that is services and research oriented, and later on develops products, and then expands, we have spun off four companies at least that I know of. And for those companies it's very necessary to be located close to some source

like Wright Patterson Air Force Base. And we've had a good relationship with people there. That's important.

But, we have to be aware of this community. It's very vigilant about losing facilities from Wright Patterson. Everybody else would like to have our facilities. What we didn't have was the other part of it, a lot of scientists in the community. As I say, we had to get 90 percent of our scientists. And as a matter of fact, Wright Patterson has six or eight of our real good people that they hired from us after a period of time. But, at that time it was a little lonely bringing in people. That's my point.

And perhaps we would have been much bigger if we had been near to one of the Air Force's large divisions in Los Angeles or if we were more devoted to NASA than we were at that time.

Representative BROWN. In the development of life, they say the seashore is very important. If you preserve the seashore both in the ocean and the land, then you encourage new life forms. I'm talking about the research and technological area where both the laboratory and the basic research done by military installations or some private entity lead to the development of new companies, that then take on a life of their own, and from that spin off additional companies.

Historically, Mead in this area was a relatively small company. It's expanded now into one of the larger business organizations in the country. And I am fascinated. There are a lot of questions I want to ask, but I want to get back to the financing of this sort of small entrepreneurial venture, much in the tradition of Colonel Deeds, Mr. Kettering, the Wright Brothers. How do you witnesses find that financing in today's market from the standpoint of the small companies? And I'd ask the same question of Mr. McSwiney, now, a larger company. How does that venture capital or confidence financing of a small business as it expands into a larger business come about? Is it easy or can it be encouraged in some other ways than it's now encouraged? What could be done to make it better?

Mr. MCSWINEY. Well, I'll answer briefly. For a large corporation it's agonizing. The four that we have, two have been brought into the black, one we started with an idea we could do it for a million dollars; $27 million later we made our first dollar. The ones that we still have on the board, I guess, the thoughts are that if we're successful in making them happen, it will take well over a million dollars to make them successful. Last week our board spent a whole meeting talking about this. We don't have a proven product at this point. How far down the line do you go? And I'm sure these fellows will tell you the same thing, the small ones as well as the large ones.

I think that's in the large companies. I don't think that's in any way a big issue with any of the smaller companies. But, one of the things larger companies have to do do is to find ways to support and nurture research and development and these kinds of products.

It's generally been thought, oddly enough, that this is a province of the smaller companies, because they have the sole attention that they need to devote to these efforts, and the large companies can't and won't do very well, or if they do, they won't stay with them long enough to see them through. So, I guess the answer to that is that no one knows it well.

97-907 0 - 82 - 5

I've made several comments over the years, which I think are fundamental to the issue. When we find times like we are in now, generally speaking, the most productive brains in this country go on the street. Like the middle management, whether they're in small organizations or large organizations, if they are discretionary items, they usually go on the street. I know that some Members of Congress have supported efforts to improve research and development. When we went through the Vietnamese war, there became a feeling that if you supported research and development in the colleges as we had done in the past, and if you could make a napalm bomb out of it q.e.d., it was bad. And we developed a whole climate that is one that has been greatly anti-American or anti-Western World society.

Somehow we must find the way to get money back into the universities to do research, and some way we must find a way to get research and development in corporations as to where it is not just a discretionary item of expenditure.

I've advocated for a number of years you just simply take research and development dollars and index them in such a way that it works a little bit in the negative way of surplus that the—not surplus, but the excess profits tax so there is an incentive to keep spending that money, because the most productive minds in our country or the most productive things are really tied in that. I can sit at the head of the table, make a decision whether we're going to do something or not, but I'm not the one who conceives and makes it happen. Smaller companies get a little closer to that.

Maybe that's enough. Maybe that's too much.

Representative BROWN. Mr. Krug, where does a good idea of entrepreneurial spirit get its financial support for the development of a corporation?

Mr. KRUG. Well, traditionally, venture capitalists. And that is one of the areas as I know it in this area, that's one of the reasons they go to Los Angeles. The venture capitalists tend to go there. It's a very difficult question, Congressman. I really can't answer that.

I think the banks in this community are as aggressive and accommodating as any city in the country; more so than some I have been in. So, I think we need to engender the region. We need to establish it as an aggressive community. We have to fight for our rights. We bought the property at I–65 in 1963, and the highway still isn't through. When you have those sorts of things, you have to bring it before the people who are considering coming into the area and so on. It's just not good. We're cleaning our house, but it's coming very slowly.

Mr. HEINE. Mr. Congressman, if I had a snappy answer to that question, I'd go out and start a company.

Mr. HUNTINGTON. Rather than just working for one.

I don't know. I am impressed that economic stability over a span of a decade rather than a year or two does seem to be rather vital. It takes a long time for research to be conducted sufficiently. To do research on a crash or emergency basis is very costly and likely to be worrying.

Likewise, the Government is vulnerable for new technology for which the market is not well established, not well in place, and requires more time than to bring out a Mead II Co., of an existing familiar

product. When interest rates swing wildly or when the Government procurement policies or research funding policies go through wild isolations for over a period of a year or two, this is not only demoralizing, but extremely restrictive for those people who have to finance research and development.

Representative BROWN. Perhaps we'll get that question or answer on another panel.

Mr. Heine, I'd say you have your work cut out for you. The environment of a community and the culture sense is important, that the environment of the community from the standpoint of venture capital supply is also important. But, perhaps the most importance comes from the support of the technical community and customer support for technical help in developing and protecting the community and their base for industrial growth. So, if you want to make a statement on how successful that can be in Dayton, you're welcome to do it, and then we'll move on to the next panel.

Mr. HEINE. Let me just say that in the past I think the intent has changed the commerce to work in retaining industry. We're embarking on a new program in the near future which will be tying the governments in this area together, and instead of retaining, we're looking into expanding. We're going to be tackling the 10 fastest growing SIC codes, searching out those firms that exist in this community. trying to help them grow so we don't lose them, but expand them.

And I think that's a whole change in philosophy as it relates to regional cooperation of this community and the image that's happening or what's going on, I'd only share with you today that I think that's beginning to change. The outspread of that is the fact that I leave to go to Washington and New York to call on some technology companies. We have been in Boston calling on the same types of companies and we have been in Los Angeles calling on the same types of companies.

The thing that's changing is that we're combining lots of people in that. And joining me in the visit to Washington and New York to call on these companies is the new mayor of Dayton who's out there promoting not just the city but the region. And I think that's a very vital thing that's going on.

When you can sit with him in Houston, Tex., and have him say, "I don't care where you locate as long as it's within 50 miles of the center of Dayton, we'll all benefit." That's an attitude that's coming, and I think bodes well for our future.

Representative BROWN. I think it's terribly important for our future, and I'll dismiss you with some bad news. We just got the unemployment rate for Ohio which was in January, 11.9; February is 12.2. For the city of Dayton, or rather the Dayton area SMSA, it hit 10.2 percent in January of 1982. So, it's high and going up. The need to attract and find new sources is obviously significant in a market where your existing sources are in some trouble.

Gentlemen, thank you.

We'll go to the next panel. Our next panel consists of Mr. Robert Kegerreis, president of Wright State University; Brother Raymond Fitz, the president of the University of Dayton; and Mr. Lynn Elfner of the Ohio Academy of Science.

Mr. Kegerreis is our host in this building today. We'll give you the opportunity to start out the panel of academics or academicians first. Mr. Robert Kegerreis of Wright State University.

STATEMENT OF ROBERT J. KEGERREIS, PRESIDENT, WRIGHT STATE UNIVERSITY, DAYTON, OHIO

Mr. KEGERREIS. Vice Chairman Brown and members of the Subcommittee on Trade, Productivity, and Economic Growth, my statement today will deal with the roles of the Federal Government and the State, Ohio in particular, as they could effectively interact with the roles of universities to encourage the creation and growth of science and technology-based companies.

Others testifying today have demonstrated that the existence of broad-scale universities, the University of Dayton and Wright State University for example on the one hand, and large Federal research establishments such as Wright Patterson Air Force Base on the other hand, have a combined, natural, but slow-moving fall-out or spill-over effect which tend both to create new science-based companies and to enhance technologically the growth of established enterprises.

Entrepreneurially minded scientists and research engineers leave universities and the labs of Wright Patterson occasionally to start their own companies or to join private industries. Some fail; others succeed. What has happened in Dayton in this regard has so far taken place with no special incentives, subsidies, financing, or encouragement from any quarter. By contrast, in North Carolina, in an area not originally noted for high technology research and development, there has arisen a mammoth research park, a dazzling concentration of research laboratories and pilot plants.

How did it happen there? Simply by a planned, sustained, cooperative effort among three universities, the State, and the Federal Government to make the selected site an attractive place for industry and governmental agencies to locate their research facilities. Can Ohio and Dayton in particular, create their own unique development in which industry, governments, and universities cooperate? The answer is yes, of course, but not without some changes in current policies and attitudes. Here are some examples of situations that need to be changed:

Contradictory as it may seem, Congress and the administration have combined to cut National Science Foundation funds, for example, which were used to pay part of the cost of purchasing scientific equipment for university research laboratories. This adversely affects the capability of universities like Wright State and the University of Dayton to keep pace with or to exhibit leadership in research, such as at Wright State, the complex computer managed industrial control systems.

At Wright State we have had to restrict enrollments in our baccalaureate and masters level computer science and computer engineering programs, which are the second largest in Ohio and which are located in the State's most intensively concentrated area of governmental and industrial research in computer system design. This has happened

at the very moment when our worldwide leadership in computer development is meeting its strongest challenge.

Another example: Ohio has a remarkable collection of economic advantages—abundant coal, unusual water sources, superior transport and logistically optimal locations, surplus of labor supply, and an excellent, mature higher educational system. Yet Ohio is losing population and industrial development to States with little water, no coal, overextended transportation systems, and relatively underdeveloped higher educational systems. The State of Ohio has a traditional department of economic development, the plan for coal research, but no funding, a statewide committee to study high technology transfer mechanisms, and a small start on one research park. That's it.

One final example among many that could be cited before I make my concluding remarks and recommendations: In the most recent session of the Ohio Legislature a capital appropriations bill in the staggering total sum of nearly $628 million was passed. In the bill were convocation centers, a football stadium, a variety of conventional well-justified university structures, but only one R. & D. expenditure; $10 million for the research park here in Dayton, or much less than 2 percent of the total.

Surely, these few examples indicate the need for a change in attitude of priorities. One of the gravest errors a company can make when its sales decline is to cut back on market research, product development, advertising, and sales efforts. Similarly, it seems ill-advised for a State or a country when facing negative population shifts, loss of markets, slippage in technological leadership to reduce expenditures for basic and applied research and equally adverse to cut back support for university capabilities to conduct meaningful research. Here are three of my recommendations for effecting a turnaround in the grievous current situation:

1. Launch an all-out effort to support the research park, including these elements:

(a) Encourage the Secretary of Defense to authorize and direct the commander of Air Force Logistics Command or Aeronautical Systems Division to designate a top-ranking officer to coordinate the campaign to have the Air Force and the Department of Defense encourage companies related with them to locate their next research lab in Dayton at the research park;

(b) Budget at the State level $1 million annually for 3 years to produce and coordinate the marketing campaign to promote the research park;

(c) Provide State and local tax incentives to encourage industry to build facilities in the research park;

(d) Provide State-backed loans to local governments to enable quick response to the need for roads, sewers, and water in the research park;

(e) Provide in the State budget a development fund of $300,000 annually for 3 years to support a management staff at the research park;

(f) Provide $100,000 annually for 3 years to the University of Dayton and Wright State University to supply faculty researchers and

scientists and part time to build up the capability of the research park, and $50,000 annually to Central State University and Sinclair Community College to provide technical assistance and training for the research park. This kind of combined effort is needed to make the research park a sure-fire success, one that can be replicated at one or two other sites in Ohio.

2. Develop a plan to establish outstanding specialized "centers of research excellence" in Ohio. We know that there are in Ohio well-recognized research-oriented universities and industries—Case Western Reserve, Battelle Memorial Institute, Ohio State, University of Cincinnati, Cincinnati Milicron Corp., and the University of Dayton. But let me use Wright State as an understandable example and the possible implementation of the plan. I mentioned earlier that Wright State has a large, very well-regarded computer science and computer engineering program in both baccalaureate and graduate levels.

Our students find employment immediately upon graduation and regrettably many are hired right out of the classroom before they complete their studies. Yet, we find it impossible to supply expensive equipment and facilities needed to keep our program with the state of the arts and to produce enough well-educated graduates to meet the demands of Government and industry. NCR, Mead, and Armco have assisted us, but it has not been enough. Here is a great opportunity to creative Government assistance. With appropriate funding Wright State can do these things:

(a) Organize an industry-government-university center of excellence in computer research, with initial participation by ASD, AFIT, Wright State, NCR, and Mead;

(b) Develop further the university program in computer science and computer engineering: (1) establish two new laboratories in the computer controls area and computer physics; (2) establish an applied science based doctoral program in computer science, that is, a DCS degree; (3) attract two new chair professors in computer science; (4) conduct contract research at the research park, either independently or in conjunction with AFIT, NCR, Mead, or ASD labs, or with the University of Dayton, Ohio State, or Case Western Reserve; and (5) establish an internationally known center of excellence which would attract computer research firms to Dayton. This model can be replicated around Ohio at carefully selected sites. For example, liquid crystal research at the University of Akron can be repeated in Dayton in other high tech fields by Wright State and the University of Dayton.

3. Provide incentives to industry to work with universities, to build up their capabilities for high tech research and development and for transferring the results to industries and new ventures.

When I talked with Congressmen about the National Science Foundation cuts last fall, they indicated that they expect industry to "fill the gap," but there apparently is no plan to provide the necessary incentive at either State or national levels to promote the industrial support we need. Given the encouragement, the universities and industries can provide plans for specific, mutually beneficial development of research capacities.

Thank you for the opportunity to appear before you and to express my concern, even alarm, at the lack of planning needed to build up Ohio's research capabilities.

Representative BROWN. Mr. Kegerreis, thank you very much.

Our next panelist is Brother Raymond Fitz of the University of Dayton. Brother Fitz.

STATEMENT OF BROTHER RAYMOND L. FITZ, S.M., PH. D., PRESIDENT, UNIVERSITY OF DAYTON

Brother FITZ. Vice Chairman Brown and members of the subcommittee, it is a privilege to appear before you today and to address the linkages between universities and business which promote the economic and social development of the region. Renewing the creative partnership between universities and business is one of the most important challenges that we face in the next decade. It will be a key ingredient in the economic recovery of this country and in our long-term efforts to build a world of peace and justice.

It is not by accident that the Miami Valley has grown, and continues to grow, as a center of advanced technology. A scientific and technical base is inherent in the area: The history of flight was written in Dayton, created with the foresight of Orville and Wilbur Wright. The determination and achievements of John Patterson and Charles Kettering are legend, with their contributions to the automotive industry and the founding of NCR.

This heritage of technical excellence speaks well for Dayton's future. Advanced technology, linking industry and education, can contribute significantly to the area's economic development. The value of increased cooperation between the research communities of university and industry cannot be overstated. Strong industry participation in research institutes at universities and long-term joint projects between university research teams and single companies can provide the opportunities for combining university research careers with economic growth of the private sector.

One of the major drivers of economic growth is the development of technology, that is, the utilization of knowledge to create products and services which will enhance human life. Technological development depends on a rich pool of knowledge and experience on one hand, and on the other, the innovative mind and dogged persistence to translate ideas into usable product and services. American universities have traditionally emphasized the necessity of basic research to increase the pool of available knowledge and experience. Since the gap between shaping this knowledge pool and the production of a profitable item may be several years, it could be easy to overlook this role of basic research. Yet, the extension of our grasp as thinking people is an essential requisite for further advances.

Industry has traditionally emphasized the transformation of the pool of knowledge into useful products and services. This creative use of the knowledge base has been essential to the viability of companies and their ability to contribute to economic growth.

Universities and business are reexamining these traditional roles and through creative exploration of new approaches are forging a re-

newed partnership for technological advancement. In the area of basic research, this partnership for technological advancement has gone in three major directions: First, new approaches to developing the infrastructure for basic research; second, ongoing programs of university exchange; and third, the ability to define common research goals. Let me develop each of these briefly.

With a continuing decline in federally funded basic research, more and more university research facilities are turning to industrial sponsorship to share the costs of major equipment and to establish joint laboratory facilities. Industrial investment in basic research will enrich the knowledge-experience pool, as it will allow scientists and engineers from both sectors to be exposed to new ideas. Long-range planning, essential to the systematic replacement and enhancement of equipment capabilities, will offer savings to university-industry teams which would otherwise purchase the equipment individually, and will provide complementary information.

The mutual development of information may be furthered with increased industrial liaison programs linking the applied research objectives of a specific technological area to ongoing research activities at universities. Through industrial liaison programs, information, consultation, and facilities are provided to industry on an informal basis, creating interaction between the two sectors. Ongoing exchange programs may be capable of spanning the innovation process from initial concept to market development.

Another challenge that is being addressed by universities and business is the defining of common research agendas. Industrial concerns tend to be product oriented, while university research centers tend to be oriented toward knowledge disciplines and problem solving approaches to knowledge. We are finding that these divergent interests can mutually enhance one another, if we are able to identify common research goals.

Universities and business also have a creative partnership in the task of education. Universities, with a commitment to society as centers of educational excellence, have a valuable role to serve while extending the knowledge shared by industry and university research interests. Graduate and postdoctoral studies can integrate education and industrially oriented projects, while offering career guidance to graduates. Continuing education, which may be distinguished from degree-related studies, can aid scientists in remaining competent in their present field, developing competency in a new field, and in preparing for increased responsibilities. Maintaining vitality and innovation among scientists and engineers is a key factor of continuing education, which may proceed along several paths. In-house courses sponsored by the company, tuition aid for university-sponsored, graduate-level work, and university course work offered on or near the company premises, all offer incentives for individual, and hence, corporate improvement. Participation in university course work is positively related to employee performance. In addition, industries have often been instrumental in having universities offer new courses in specialities required by their scientists and engineers. Keeping up-to-date with new developments in a given field is difficult for many professionals, and courses devel-

oped by industrial or university sponsors can efficiently channel newly generated findings to these individuals.

Business for its part can assist the universities in its educational mission. A prime example of this linkage is the cooperative educational program. Perhaps the most important contribution of these programs is the opportunity for students to contribute to the innovation process and to technological development. The addition of trained scientists and engineers to the knowledge-experience pool results from students spending part of the academic year in the classroom and the remainder in an industrial setting. Presently, at the University of Dayton, 350 students have been placed with 103 firms in cooperative positions. For approximately 16 weeks, students acquire experience with either the university or a local company, receiving on-the-job training and career identification.

These new linkages of cooperation between business and education on the tasks of basic research and education, have come out of an awareness of our responsibility to work together for the economic development of society. Yet, at the same time, we must be aware of our responsibility for the moral and cultural dimensions and impacts of economic and technological growth. Both business and universities must jointly create forums of reflection, debate, and moral dialog on the consequences of economic and technological growth. We must critically ask the question of whether technology is indeed enhancing human life and creating a world of peace and justice. This is not just a question for a marginal group of professors and students to address, but one which must engage both universities and business.

Any investment by a university or industry must produce tangible returns for all in order to maintain involvement. The Miami Valley Research Foundation is one such creative investment of manpower and money. Its several academic members will facilitate the transfer of basic and applied science and technological research to the production, manufacture, and marketing of materials and services. The Miami Valley Research Foundation has identified eight areas which represent the collective interests of members: Computer and information science; materials science; biomedical engineering; medical services; environmental systems; energy—its exploration and utilization; applied mathematics; and aeronautical, astronautical, and allied sciences. At present, within these 8 areas, 175 professional research personnel are actively pursuing 375 different basic and applied projects. One of the research foundation's functions will be to recruit research enterprises from industry, business, Government, and education, engaging the research personnel and facilities of more than one, if not all, of its members.

The close proximity of the researchers will permit a more rapid growth of spinoff technologies. Air Force and other defense-related research will promote growth in the civilian sector which will outweigh its benefits to the military. Innovations in health care, fire fighting, and civilian flight safety, will be among the results of the solicited research contracts. In the future, in Dayton, technological progress will be linked to industry and universities, because advanced technology begins with thinking people.

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Representative BROWN. Brother Fitz, thank you very much for your statement.

Our final witness is Mr. Lynn Elfner from the Ohio Academy of Science.

STATEMENT OF LYNN E. ELFNER, EXECUTIVE OFFICER, THE OHIO ACADEMY OF SCIENCE

Mr. ELFNER. Congressman Brown and members of this distinguished subcommittee, good morning. I am Lynn Elfner, executive officer of the Ohio Academy of Science. I appreciate the opportunity afforded by Congressman Brown's invitation to appear before you this morning as we focus on the role that advanced technology has to play in regional economic development. I have been asked to comment on the quality of science education in Ohio to help assess the potential of developing new science-based industries in Ohio with implications for other industrial States. Specifically I have been asked to answer three questions:

What can be done to improve Ohio's scientific resources?

Is Ohio's supply of scientists and engineers adequate to meet the needs of its emerging high technology sectors?

Is Ohio keeping pace with other States in science education?

Before I address these questions, let me tell you about the Ohio Academy of Science.

In 1891 the promise of hearty cooperation from a goodly number of Ohio scientists sparked the establishment of the Ohio Academy of Science—one of this Nation's leading scientific organizations. Wisdom, vision, and leadership have enabled the academy to grow, serve society and influence an ever widening circle of members and friends in Ohio, many other States and in several foreign countries. Many changes have occurred since our founding, but one thing remains constant: The need to maintain and improve the climate for innovation and discovery. This climate has been remarkably aided by the persistent, enthusiastic pursuit of the academy's objectives: to stimulate interest in the sciences; to promote research; to improve instruction in the sciences; to disseminate scientific knowledge; and to recognize high achievements in attaining these objectives.

Nearly a century of service has earned the academy the respect and reputation as the common meeting ground of the scientific activities of the State.

If the late Charles Kettering were here today I suspect he would have a broad smile on his face. His sustained personal interest and financial support during the last decade of his life coupled with additional help from Battelle Memorial Institute enable the academy to establish an executive office in 1959. This event resulted in a significant advancement of our work. Now our influence is felt throughout Ohio, many other States and in foreign countries. We are considered a model among other States having science academies. What we do in Ohio frequently is adopted elsewhere. With this context in mind, let me address the three questions.

What can be done to improve Ohio's scientific resources?

A glance at the most recent copy of the Ohio R. & D. Facilities Directory will help identify over 600 specific research and development programs. While this is a useful document, I know that for various reasons there are many scores of other programs too. The point is, Ohio has many scientific resources in our college and universities, businesses and industries, hospitals, research institutes, and governmental agencies. Unfortunately, I believe they are too balkanized or broken up into smaller and often hostile units. This happens on campuses and I suspect within corporations; it also occurs between institutions and organizations, too. With the extreme problems of the economy, I suggest it may get worse before it gets better. Few statewide or even regional within the State mechanisms exist to pool resources and expertise toward the solution of common problems. All elements must compromise.

We hear a lot these days about the need for cooperation between business and industry, universities and Government. But on a clear day you can hear a lot of voices but you can see practically nothing. I hope that by saying this someone will come out of the woodwork to challenge me so I can take their example and share it with others. We are like what Clement Attlee once said in a different context, "We are disparate, desperate people shouting at each other over seas of misunderstanding." About the only statewide mechanism to bridge these gaps is the annual meeting of the Ohio Academy of Science.

This April 23–25 at the Ohio State University we'll have over 370 technical presentations from researchers at universities, a few governmental agencies and a few industries and businesses. Two special symposia—on "Emerging Technology" and on "Robotics"—will, in fact, bring together leaders in academia with business and industry. Science academies elsewhere have the same potential to develop this same mechanism to destroy the lines of balkanism and begin to work together toward mutual goals.

Another major problem with Ohio's scientific resources is outdated equipment. Since I anticipate that others at this hearing, much closer to this problem, will dwell on it in more convincing detail, let me simply point out that make no mistake about it—science is expensive and requires up-to-date equipment at major capital costs both to attract research grants and to educate graduate students.

While those involved in science policy are familiar with the extent of Ohio's scientific resources, most of the scientific community statewide and I suspect locally are simply unaware of our rich endowment. Certainly few of our congressional and State legislative leaders have a good grasp of what is going on in scientific research across this State and how this can contribute to economic development. A few years ago, for example, at one of our annual meetings held at Wright State University, I received a call from a State economic development official who told me the Ohio Academy of Science had no business discussing Ohio economic development policy. This is a good (or bad) example of balkanization. Ironically, the State is now pursuing the very policies discussed by economists at our meeting 5 years ago. I don't think anyone has a monopoly on ideas for economic development.

Many of those in Ohio's scientific community have been reticent to "toot their own horn." Sometimes it is necessary to brag at least a little, so others will come out and tell their story too.

Is Ohio's supply of scientists and engineers adequate to meet the needs of its emerging high-technology sectors?

To answer this question let me turn to a recent "Survey of Leading Figures in the Field and Research and Development in Ohio." In this massive volume, compiled by the Ohio Development Financing Commission, are the candid comments of top people at many well known Ohio companies like Battelle Memorial Institute, Goodyear, Procter & Gamble, NCR, Monsanto, TRW, and the Charles K. Kettering Foundation. I found the observations of Mr. H. F. Lanier of Goodyear Aerospace particularly instructive. He says:

> The second problem encountered by Goodyear lies in its difficulty in recruiting technical and scientific personnel. Goodyear has learned, through long experience, that technical employees who have familial, cultural, or educational ties and affinities with the Midwest tend to remain with the company over time. Personnel recruited from outside the Midwest—from the two coasts, for example—tend to return to those areas as soon as a suitable opportunity arises. As a result, Goodyear tends to concentrate its recruiting efforts in the Midwest. Universities in the Midwest are not graduating scientific and technical people in sufficient numbers to meet the demands of business and industry. This not only causes manpower shortages, but inevitably raises the cost of recruiting and retaining personnel to engage in R&D. It also increases the company's dependence on subcontractors, or consultants, which again are recruited primarily from nonlocal sources.

In arranging our Robotics symposium this year I spoke with the vice president for research at one of Ohio's robot manufacturers. He has been an academy member for several years and sees the value of our work in science education. He told me that, right now, his product is limited because he can't get the researchers he needs and he's not sure where they will come from.

Also of note and concern to Ohio's academic and economic leaders should be the fact that the "brain drain" noted on several occasions by William Papier, director of research and statistics for the Ohio Bureau of Employment Services, may start in high school. Statistics from our 1981 and 1982 Ohio-Westinghouse science talent searches indicate that 36 percent of these top students are headed out-of-State to places like Harvard, MIT, Johns Hopkins, Brown, and Notre Dame. For the economic future of Ohio we've got to make sure they come back. I don't think we even know what happens to them after college graduation. And I doubt that most of Ohio's corporations are doing anything to go after them. Students who participate in our program can provide the human capital vital to high technology.

Is Ohio keeping pace with other States in science education?

The answer to this question is "Yes" if we compare out-of-school programs like those offered by the Ohio Academy of Science through our local, district, and State science days. Since their founding in the late 1940's, these programs have influenced well over 250,000 students. In this area, Wright State University hosts our district science days. Furthermore, many fine institutions and organizations like the nearby Dayton Museum of Natural History, enhance the public understanding of science and assist in the science education of thousands of ele-

mentary and secondary students each year. This year I'm very proud that the Dayton Museum of Natural History is hosting the Montgomery County science day.

For more than 20 years, with financial support from Battelle Memorial Institute, we have annually provided Krecker Awards for outstanding science education programs in Ohio's schools. During that time more than 150 Ohio schools, including several in the Dayton area, have been selected. I'm sure that at least some of these schools are doing as good a job in science education as any schools in the Nation. Award criteria include: (1) Teacher qualification; (2) nature and quality of the science experiences in the schools including special programs for talented students; (3) efforts to create interest in science including science days and the nature of cooperation between school, community, and industrial organizations like manufacturers, research labs, and public utilities; (4) extent of cooperation among faculty, administration, and the community; (5) lab facilities and materials; (6) budget; and (7) affiliation with our junior academy programs.

In sharp contrast to these private efforts is the fact that science education in the Ohio Department of Education is virtually ignored, with the possible exception of the Annual Martin Essex School for the Gifted and Talented. Ohio has not had a science education supervisor since August 1980, and I understand that we will not have one until July of this year. At that time someone will be assigned the responsibility on a one-third time basis only. In a major industrial State like Ohio, struggling to attract high technology, this lack of concern for science education is embarrassing.

Ohio currently is revising its minimum standards for education. The Ohio Academy of Science has submitted testimony on science education, but since the Ohio Department of Education has been without a science education curriculum supervisor for nearly 2 years, science education is at a distinct disadvantage. Here is an issue where Ohio's university and business leaders need to apply pressure so that the students you get will not have to be brought up to date because of their lack of science education.

While Ohio's public leadership in science education is dismal, the Federal leadership is even worse. Not all of my colleagues will agree, but the millions of dollars spent in the last 15 years by the National Science Foundation on curriculum studies would have been better spent on local and State programs for science education of direct benefit to the people. When we ran the largest visiting scholars program (formerly called by NSF the visiting scentists program) in the Nation with support from NSF and industry we reached over 9,477 classes through 3,080 visits and over 600,000 students. This program, also available to other States, was cut by NSF in 1966. Other examples of good NSF programs can be cited too which benefited people directly. I can supply descriptions of them.

A national disgrace has developed in the proposed fiscal year 1983 budget of the National Science Foundation. Only $15 million is budgeted for science education or 1.4 percent of the total agency budget of $1.0728 billion. The NSF reaction has been to allocate $700,000 in fiscal year 1982 to establish an ad hoc commission on precollege education in mathematics, science and technology to study the problem.

Not a single penny of this $700,000 will have an immediate impact on the quality of science education in America.

Two years ago NSF published eight volumes of reports on the status of precollege science, mathematics, and social studies education. Now we have yet another study commission. Frankly, science education at the national level is being commissioned to death.

In summary let me quote from a recent editorial in High Technology magazine entitled "Technology Leadership: A New World War." Paraphrasing the editor, he said that thousands of well-educated, motivated individuals with the freedom to innovate, the capital to launch creative new ventures, and the incentives to achieve success despite formidable obstacles can provide a richer, more balanced set of steadily improving technologies than have the United States adopt an approach of focusing on just a few emerging technologies. Regardless of your view, it seems clear to me that we are engaged in a great world economic war where brains and not brawn are important. And I believe that science education is the forgotten weapon in the battle for high technology. Remember, as Pasteur once remarked, "In the fields of observation chance favors only the mind that is prepared." Thank you very much.

[The material attached to Mr. Elfner's statement follows:]

SYMPOSIA

91st Annual Meeting
The Ohio Academy of Science
April 23-25, 1982
Hosted by The Ohio State University

Friday April 23, 1982

EMERGING INDUSTRIAL TECHNOLOGIES AND THEIR ECONOMIC IMPACT

Arranged by Dr. Herman J. Eichel, President of Adria Laboratories, Inc. and Vice President for Economics of The Ohio Academy of Science

HIGH TECHNOLOGY INDUSTRIES AND ECONOMIC DEVELOPMENT. Dr. Robert Premus, Economist, Joint Economic Committee, U. S. Congress, 359 House Annex 2, 3rd & D. Streets, SW, Washington, DC 20515.

IMPACT OF TECHNOLOGY -- ALTERNATIVE STRATEGIES. Jules J. Duga, Ph.D., Principal Researcher, Resource Management & Economic Analyses Department. Battelle Columbus Division. 505 King Avenue, Columbus, Ohio 43201.

STRATEGIC PLANNING OF TECHNOLOGY TRANSFER. Warren H. Groff, Vice President for Academic Affairs, North Central Technical College, 2441 Kenwood Circle, Mansfield, Ohio 44901.

STRATEGY FOR ACCELERATING R & D ACTIVITY. Tom Walker; Director, Ohio Development Financing Commission. 30 E. Broad St., Columbus, Ohio 43216.

DEVELOPING A COMMUNITY'S HIGH TECHNOLOGY RESOURCE BASE: THE DAYTON CASE. John B. Cordrey, Dayton Development Council, 1940 Winters Bank Tower, Dayton, Ohio 45423.

FINANCING EMERGING TECHNOLOGY. Barry Winslow, Senior Vice President, Huntington National Bank, P.O. Box 1054, Cincinnati, Ohio 45202.

Saturday April 24, 1982

ROBOTICS

Arranged by Dr. Russell A. Primrose, Dean, School of Engineering of the University of Dayton and Vice President for Engineering of The Ohio Academy of Science

THE INDUSTRIAL ROBOT AS TRANSFER DEVICE. Vernon L. Mangold, President, KOHOL Systems, Inc., P.O. Box 1185, Dayton, Ohio 45401.

DESIGN OF A PORTABLE INSTRUMENTATION ROBOT FOR AUTOMATING ACOUSTIC INTENSITY ANALYSIS. John Coy, Ivan Morse, Dave Stephens, Will Atherton and Patrick Flanagan, The University of Cincinnati, Dept. of Mechanical and Industrial Engineering, Mail Location 72, Cincinnati, Ohio 45221.

SOME ROBOTICS DESIGN SOLUTIONS ARE SUGGESTED BY BIOLOGICAL MODELS. Dr. Dana B. Rogers, Box 24268, Dayton, Ohio 45424.

DESIGN OF A COMPUTER-CONTROLLED INDUSTRIAL ROBOT FOR MAXIMUM APPLICATION FLEXIBILITY. Ronald L. Tarvin, Research Associate, Robot Research, Dept. 03E, Cincinnati Milacron, Inc., 4701 Marburg Avenue, Cincinnati, Ohio 45209.

THE NORDSON ROBOT SYSTEM. Ernie Fena, Technical Training Manager, Robotics Division, Nordson Corporation, 4937 Mills Industrial Park, North Ridgeville, Ohio 44039.

THE IMPACT OF ROBOTICS UPON EDUCATION. Dr. Russell A. Primrose, Dean, School of Engineering, University of Dayton, Dayton, Ohio 45469.

EXECUTIVE OFFICE

WRITTEN TESTIMONY TO THE OHIO DEPARTMENT OF EDUCATION

CONCERNING STATE STANDARDS FOR OHIO SCHOOLS--

PRESENTED ON BEHALF OF THE OHIO ACADEMY OF SCIENCE

Issues, such as the causes and effects of acid rain and the disposal of hazardous waste, that have been capturing the headlines of Ohio's newspapers in the last several months point to the continuing need for strong educational programs in science in Ohio Schools. Our citizens are repeatedly asked to form opinions on issues that require a basic understanding of the methods and knowledge of science. Ohio's industry and government have continuing needs for highly-trained personnel in engineering and science to produce high-technology products and to solve problems relating to efficient use of our resources. President Carter, reflecting a concern at the national level about a growing shortage of engineers, recently directed the National Science Foundation and the Department of Education to assess the quality of science and engineering education in the country.

The membership of the Ohio Academy of Science, concerned about the continuing availability of trained personnel in scientific and technical fields and for the education of a public informed in science and technically-related matters respectfully submits in this testimony a series of recommended standards to the Ohio Department of Education which, if implemented, will help to insure a minimum education in science for Ohio children. In addition, the adoption of these recommended standards will accommodate some of the concerns regarding the reading and language skills of Ohio children, since there is substantial evidence from research on activity-based science programs at the elementary and junior high school levels that such programs lead to improved language and reading performance. This evidence is summarized in an article by Ruth T. Wellman, "Science: A basic for language and reading development" in What Research Says to the Science Teacher, Volume 1, edited by Mary Bud Rowe, published by the National Science Teachers Association, 1978, pages 1-12. Other studies have provided evidence that activity-based science programs result in stronger logic development among children, the improvement of strategies used in problem solving and in improved attitudes toward science.

These characteristics are needed in our citizens, our business, industrial and political leaders, and our opinion leaders to help insure the development of wise policies and decisions.

The following are therefore recommended as required minimum standards for science:

Grades one through six.

1. Every school shall provide an activity-based science program where children learn about the natural environment through working with materials from that environment.

2. The following minimum times shall be devoted to science instruction:

   a. Grades one through three--120 minutes per week.

   b. Grades four through six---200 minutes per week.

3. Each elementary school shall have the equipment and materials necessary for conducting an activity-based science program.

4. Each school board shall provide and require the equivalent of one day of inservice education in science per year for each elementary school teacher.

Grades seven through nine.

1. A full year of science shall be required in each of the three grade levels.

2. Each of the science areas--earth science(geology, meteorology, oceanography and astronomy), life science (biology and health) and physical science (chemistry and physics)--shall be represented equally across the three grade levels. Upon completion of the ninth grade each student shall have attained the equivalent of one year of background in each of the three science areas.

3. The science program shall devote a minimum of two-fifths of the total time to laboratory experiences.

4. Science shall be taught for a minimum of five 45-minute periods each week.

5. Each science classroom shall be equipped with the utilities, equipment and materials necessary to run a laboratory science course.

High Schools.

1. Every high school shall offer laboratory courses in each of the three science areas: earth science, life science and physical science.

2. Every high school graduate shall have completed a minimum of two Carnegie units of laboratory science in grades nine through twelve.

3. Present standards for laboratory courses (160 hours per year) shall be maintained, however, additional Carnegie units can be assigned by schools to such laboratory courses in recognition of the additional time students devote to them.

All other standards pertaining to science from the 1968 version that are not superseded by those mentioned above are also supported by the Academy.

We are encouraged that the Department is now involved in revising its minimum standards. Much has happened in the past twelve years that require the updating of the standards. This is especially true in science with the advent of the energy crisis, America's slipping position with respect to the other developed countries in science and technology and the accumulation of research evidence on the effectiveness of science programs, especially in the promoting of reading and language development. It is essential that the new standards reflect this growing importance implied for science in the school curriculum.

June 2, 1980

Statement approved by the Executive Committee of The Ohio Academy of Science on May 31, 1980.

Representative BROWN. I thank you very much. I thank all of you for some very good and very strong statements.

I must tell you, Mr. Kegerreis, with reference to your comments about the "Research Triangle," that as a graduate of Duke University I can remember the days when Duke and the University of North Carolina and North Carolina State did not speak to each other except over basketball or football. And in the days when I was there, there were two jobs available in the area. One was in the tobacco fields and the other was in the cigarette factories.

Now, the situation is changed some, and perhaps that same progress can be made here with the same kind of attention to cooperation.

A number of questions, and I would address them perhaps to the two academics, if Mr. Elfner will allow me to make the distinction. The first, increased accessibility to university laboratories by small companies, or for that matter big ones, is a key to the future success of those companies. Can it be also a key to the future of the universities' financial stability by asking a fee, for instance, for the use of those labs, and then, the personnel at the university? Or to be more specific and sophisticated, a kind of Harvard-Du Pont genetic research project relationship that would help the financing of higher education directly from the private community.

Mr. KEGERREIS. Well, I think in both the case of——

Representative BROWN. Why are you smiling? [Laughter.]

Mr. KEGERREIS. Well, it was a multifaceted question, I believe, would be the way to describe it. But, the first question you asked was about access to academic laboratories. I think in both cases of UD and Wright State and, of course, hundreds of other universities, those labs which have a commercial immediate applicability or service to offer do indeed offer that service, and in most cases charge a fee. Sometimes it is not a full cost-carrying fee because of subsidies of various kinds, but our Brehm Laboratory at Wright State, to just use one example, has a list of nearly 100 clients across the country for materials analysis and toxicological analysis and environmental systems analysis and the like. And that's just one of our labs at the university with that kind of relationship.

We have to be very careful not to turn an academic institution, of course, into a contract laboratory. And it's a nice balance, and that's why the genetic laboratory cooperative corporation at which you—to which you referred in the case of Harvard provided such stress for the campus. There was a great deal of concern about whether or not one would dominate the other, and whether there would be a sufficient distance between the two. But, I'd turn that part of your question around, I think, and say that universities are falling behind, I believe, going across the whole range of scientific and high technological engineering laboratories, falling behind in sophistication and quality in their laboratory facilities. And I think the question may very well be in the other direction. How can universities access some of the better jobs in the industrial sector? That is even more difficult to arrange in many cases than the reverse because of certain proprietary interests and worries about competitive advantages.

I'll leave the rest of the question, though, for Brother Ray.

Brother FITZ. Just as on Wright State's campus, the university has been involved with many industrial sponsors of research, and this has been a very effective way for our researchers to exchange, to work with industrial sponsors. The difficulty that is in this is probably twofold. One is that we have been able to do this with our present equipment, and clearly because again of the cutbacks in the National Science Foundation and other sources, this equipment is becoming antiquated quite fast, and the technological era of the new equipment has a life of about 5 years, and you must replace it. This just isn't happening. Both in the State-supported sector and in the independent sector, and many times the front line challenges that industrial sponsors are looking at but are not able to address because the equipment is not on our campuses. The challenge that I think is there for the interaction, and both of the campuses have responded in some small way, is that industry would help capitalize this equipment. I think we have to go much further and it's going to be a very painful process of trying to get this to happen.

The second danger, and I've alluded to it in some ways that I see, is that basic research in this country has endured and has grown because there has been free access of knowledge, and so that ideas that have been developed in university laboratories have been able to be known, quite frequently published in journals and shared across the country. This kind of spontaneous growth of knowledge is very important for the process of technological development. Oftentimes, though, the industrial sponsor is not going to free his research capital unless you give some proprietary notion of this research developed there. And this causes a great deal of consternation on our campuses, and oftentimes does not allow us to engage in what would be profitable and very helpful research on our campuses because of the proprietary nature of that research.

Representative BROWN. I don't want to be cheeky, but it seems to me that there is also need for a university to maintain the quality of its athletic equipment, and there seems to be a way that that all gets worked out.

Brother FITZ. I would like to have you come and visit our campus and take a look at the facilities, and probably Bob could do the same thing, that probably there is a great deal of sanity in this region over athletic equipment.

Representative BROWN. It seems to me that that is being done in some other fields. In other words, in some of the universities around the country, the academic staff consults with businesses, both large and small businesses, and does make a living outside the university pay scale for some academicians. Perhaps access to scientific laboratories, scientific advice might be accomplished in some of the same ways. It also seems to me that it could be applicable to scholarships for student education.

I have a very small business interest as you know. I have an interest in a very small business, maybe I should say it that way. And we are currently financing two of our executives in postgraduate education, and that interest does make us want to pursue the kind of courses that they're taking and the kind of information available through the uni-

versity to those students. And again, the laboratory relationship seems to me one possible undertaking. I don't press the subject further.

Can the State change its tax laws to encourage private industry to underwrite a greater share of the university laboratory and equipment costs in the same way the tax laws encourage contributions to institutions generally?

Mr. KEGERREIS. Yes, I think they can. I think both in the case of property taxes and in the case of State income tax, incentives could be worked out so that these cooperative ventures and outright gifts could be encouraged. One of the closest alliances between academic pursuits and private enterprise in this country is in the field of research. And in our Wright State's case, our geology department over the past few years has received in the neighborhood of $1 million worth of equipment from 25 or 30 energy companies. And the professors do consulting as well as basic research in the field of seismic exploration and subterranean profiling. In the case of energy companies, the basic research that professors do is almost immediately applicable, so that there's a very quick transfer of this technology to applications and to exploration. That's not necessarily the case in some of the other basic research areas, however, and the previous panel alluded to the fact that it sometimes takes 5, 10, 15, even 20 years before you find out you made a mistake or that you're about to find out you've had a success.

Representative BROWN. I don't want to belabor this too much further, but Brother Fitz, you mentioned it creates consternation on the campus. I'm not sure I'm making the right conclusion here. Is that consternation within the academic or within the professorial community about how things get worked out financially, who's got the patent rights and so forth, or is it consternation within the student community about whether or not it's appropriate for the university which is nurturing them to be involved in some of this hardheaded business activity?

Brother FITZ. I think the concerns are twofold, and you've alluded to both of those, but probably with a little different nuance. I think that there are always the economic issues to be worked out and who has the rights to patents and the license and those issues, but I think a bigger issue with many of the faculty, certainly many of the better research facilities, is if I'm going to do research, what are the rights I have to publish this information and to promote my own career as an outstanding researcher? This, I think, is a very important issue. Again, I think——

Representative BROWN. I think the universities have encouraged the publishing philosophy to get people involved in the real world and out of the ivory tower over the last generation or so.

Brother FITZ. Well, I think that's mostly been the people that are concerned about knowledge, the accessibility of their knowledge, the people that have published well and have really not been under too much pressure to the really top-flight scientists and researchers in their own particular field. It's a concern that they have built up research activities and have been involved in these problems and would like to get a wider distribution of that knowledge. I think that's the key issue. I think students, again, are always concerned

about the relationship of their activities. They are quite concerned they will have a career when they finish their university activity. And I think oftentimes their participation in industrial sponsored research activities on the campus has been a very positive benefit to enhancing their own career paths and moving into industry. So, I think it's been very beneficial in a way, and there's not a great deal of concern that such activities are on the campus.

Representative BROWN. I want to say to you, Mr. Elfner, that the question of gifts or hired laboratory facilities, the financing of them either directly as gifts through change in State law to encourage that, or the laboratory facilities as a means of hired use or whatever, could apply also, it seems to me, to Ohio schools or secondary education institutions around the State if it were properly encouraged, and that scientific engineering and technological interest at that elementary and secondary level might be stimulated in that way. Would you agree?

Mr. ELFNER. I would agree. In fact, that idea is not new. We pursued it about 10 years ago, but what we need is seed money to publicize the notes first of all of the schools, and then to be contacted by the specific industries to make that switch. It already occurs. Bell Telephone is a very good example. They donate thousands of dollars of equipment.

Representative BROWN. New or used.

Mr. ELFNER. It's used equipment.

Representative BROWN. Is that helpful?

Mr. ELFNER. Yes; because it's far in advance of what the schools can afford to have. And that's an advancement, and certainly something that should be encouraged. I don't think for those kinds of donations that there's any need for tax laws. I'm not a tax law expert, but they're already doing something. We need to be important, we need to recognize the companies from Ohio and to let the teachers in elementary education know that sometimes all they have to do is ask. I've had the experience myself.

Representative BROWN. Why do we have no MIT's or Berkeleys, or for that matter, Harvard or Stanford law schools in Ohio? Are we too oriented to legality as opposed to excellence?

Mr. KEGERREIS. I'm tempted to quote, Congressman, the swan song or last lecture to the faculty of the departing Kent State University president who blasted Ohio for its lack of investment in higher education.

Representative BROWN. Be careful. We have no desire to lose you in your role. [Laughter.]

Mr. KEGERREIS. But, there is a marvelously complex system of higher education in Ohio. We have nearly 80 colleges and universities in this State. The bulk of them are liberal arts colleges offering the baccalaureate degree, and in some cases, teacher education. I think the difference is that in Ohio there has not been the kind of concentration on establishing what I was referring to in one of my recommendations, that is to say, centers of excellence, and in not necessarily promoting adequately those that we have. At Ohio State, for example, it ranges in terms of the prestige of its graduate programs at the doctoral level immediately behind and very close to the University of Michigan in

the Midwest. But, it's not generally known for that, and in that position of a close second place, is not as well recognized within Ohio as it is on our borders. But, MIT and Harvard, of course, have very specific, as Stanford, very specific origins with a unique history and explanation for their development. Since I am a Michiganite by birth, I won't fall prey to that trap, but Brother Ray, whose own doctoral field is high technology, might have an explanation as to why there's no MIT, per se, in Ohio.

Brother FITZ. Bob, it's taken me in a little bit different direction. I think one of the things in answer to Bob's question, the reason we don't have the cluster of scientists and magnets that these larger institutions have by a long tradition in history, we have not endeavored to build that, as Bob indicated, centers of excellence. I think that's a very good concept. And the Harvards and MIT's and the Stanfords have over 100 years of tradition of doing this and having that kind of advanced notion. But one thing I think is very important is not to underestimate the excellence, and certainly the beginning excellence that is in our institutions. And again, I would take our own case here in the Miami Valley region. If you would take the funded research, and I'll give you four fields, mathematics, physics, computer science, and biological science, and engineering, sorry, I gave you five, if you would take the combined Government research of our institutions of primarily Wright State and the University of Dayton, that exceeds the funded research of the universities in the research triangle. Yet, the research triangle is known as the hotbed of technological development, but in point of fact, more funded research is going on right in the Miami Valley. Again——

Representative BROWN. Let me stop you right there. Is that a public relations problem or a problem in the quality of what's produced with the research dollars? It seems to me you could make two or three interpretations of the impact of what you've said.

Brother FITZ. Yes; I think there are several points to be made. One is that it is a fairly well-kept secret of what is available in this particular Miami Valley region.

Representative BROWN. Public relations aspect.

Brother FITZ. Public relation aspect. I think there's a second one, and this is what the Miami Valley Research Institute is attempting to address, is to come together now for eight centers of excellence that we have defined here which will have a more visible and, I think, a more immediate payoff to the industrial and business sector in terms of our needs and activities. And given a period of time, again, unfortunately it's 5 to 10 years until you get some payoffs in these areas, I do think the region will be known as one of the leaders in this area of technological development.

Representative BROWN. I want to give Mr. Elfner an opportunity to respond to this, but my next question is how important is it to identify the areas of regional specialization of study, research and development, in focusing attention on the economic future of the area? And I gather that you both are arguing that it is important to focus that specifically to accomplish the excellence that I've alluded to in the earlier question.

Brother FITZ. I think in addition to that, it's important for us to identify, and this is where we're beginning discussion and dialog on this to establish a lead institution that will be the banner carrier of this particular field, and then using the resources of other institutions, I think, which will be very important.

Representative BROWN. Mr. Elfner, I will come back to you. Would you suggest, then, that if this were to be accomplished around the State or around the country, that you may want to move the Akron community, Akron, Kent State, that area, into things like Palmer research that relates to the rubber industry, Toledo University, Bowling Green, into research in glass and existing industries, plus whatever other industries might spin away from those or whatever might be the newly developing industries in that area that would lead to specialization? I think in terms, again, of a growing industry in the Cleveland area, which is the Cleveland Clinic, the medical field or some medical research.

Brother FITZ. I would say that the one difficulty that that proposal has, it's a very good one, I think the one we're trying to pursue here is to be able to have that foresight of what is going to be the next thing along the line in technological development that may characterize a particular region. It may be rubber for Akron, or it may be glass and so on for Toledo. But, if you go to those particular cities today, where are they going to go next? What's the next step for them? It seems that if they continue on the same paths or in the same focus, they could be in some economic trouble.

Representative BROWN. That's a very crucial point. I mean, you don't go around looking at barns for Colonel Deeds. I suppose you almost have to go again to a financial institution, or is there even a way to bring together the people in a community to say, "All you entrepreneurs or all you research folks that think they have a bright idea, come in and you sit on that side of the auditorium, and the entrepreneurs that are further along, sit on that side but a little bit in another section, and we'll put the folks who have the facilities that you may want to use on the other side of the auditorium, and those who have the venture capital on the other side of the auditorium, and we'll have round table discussions." And out of all that, we'll come up with direction to some extent for the educational institutions and vocational training schools and so forth as to what kind of future we want to focus on in this area. I mean, that may sound screwy, but if you can give me a better idea, I'll be glad to accept the modification.

Brother FITZ. I think it's a very positive process, and it's one that certainly we have been trying to pursue, at least in some aspects here, in the Miami Valley region.

Mr. KEGERREIS. I think there's another way to look at it, too, and that's the age old split between basic research and applied research. The genetic engineering firms on the two coasts were begun not with a sense of applied research in mind, but the most basic research that's been conducted in biological science. And it took quite a while to grow from the Nobel Prize winning work 15 years ago at Harvard into what is now genetics engineering. Your example, Congressman, was in applied research, and I think that's what we have been talking about in the research park concept here in Dayton, that is, to get the swiftest

possible technological transfer into jobs to reduce the unemployment rate, rather than to try to create new fields of basic science. But, it is our ability to forecast what the next genetic engineering area could be that would really put Ohio and any of our metropolitan areas in our university centers on the map over the long run. That's the forecasting problem that Brother Fitz was talking about.

Representative BROWN. Well, it seems to me there are two issues here. One is whether you want Henry Ford and want to grow up to be Detroit, or whether you want Colonel Deeds and Boss Kettering and want to continue to be a genesis area for new concepts. We have had our prosperity from some of the Detroit side of the fence, but the future seems to me to belong to the genesis part of the operation much more than the production part of the operation.

Mr. Elfner, I didn't mean to get away from you. Do you want to make a comment about excellence with reference to Ohio education?

Mr. ELFNER. I think it's an historical problem, at least for the last 15 years in terms of what's been emphasized in the budget of higher education in Ohio. And that was alluded to by Mr. Kegerreis on the current capital apropriations budget. If you look at the activities where there have been millions of dollars in terms of capital investments, they're not intellectually related investments; that is, buildings certainly are important, but what goes on inside those are even more important.

I was struck by the contrast a year or so ago when I visited Harvard in terms of the Harvard yard and facilities there, and the impression it created is an old rundown campus. The impression on Ohio State University's campus, at least, in the medical complex and elsewhere is a modern city. But, the difference is what goes on inside those buildings, and not the impression on the outside. Now, we have been preoccupied in the State with buildings, and I recall 15 years ago the criticism of establishing Wright State University. And the criticism was for the buildings there. Unfortunately for the critics, what's happened in those buildings has been much greater than the buildings, and there has been a great university developed out of it. So, I think there's been a preoccupation with the things that are easy to draw straight lines and build things and so forth. And it's difficult to grasp what goes on in the mind, and to see it takes more than one year or more than a biennium to possibly develop high technology or intellectual activities. And it takes sustained support. That point was made earlier. It takes sustained support to foster these kinds of things.

And another point that's been mentioned here is I think we do a very bad job of promoting what we have. If you look at the research in this area here, and if you put all that together, it is considerable. It's very large. But as I've said in my statement, it's the best kept secret in the State. Of people from out of the State, some may know about it, but most of the people in Ohio are really not aware of the extent of research that goes on here.

One more thing. The Liquid Crystal Institute has been mentioned. Ironically, that was mentioned at the congressional hearing 2 weeks ago in Columbus and used as an example that most people in Ohio don't know it exists, but people all over the world know that it exists. It just so happens that the person that established that is a former

president of the Academy of Science. His presidential address was a pure physics lecture on the difference between liquids, solids, and gases, which was a fundamental knowledge used to establish that institute. And now it's world known.

Representative BROWN. How are the academic standards established in terms of the point that you mentioned about their being under review currently in public education. Also, how and I might ask Mr. Kegerreis at the State level and perhaps Brother Fitz at the private school level, how are the directions of excellence going to be established in higher education and elementary and secondary education in the future?

Mr. ELFNER. Let me comment with a little bit of perspective. Ten years ago I worked for the Office of Budget and Management in Ohio, or a little less than 10 years ago. 8 years ago, and at that time when we were putting together the budgets for the Ohio Board of Regents and the Ohio Department of Education, it was not possible to physically or mentally get the staffs of the department of education and the board of regents. We tried, because what one was doing affected the other. And by "affected," I mean millions of dollars. One was doing one thing that was having a direct effect on teacher preparation and so forth. Fortunately, that attitude has changed. I've seen some turnaround. There have been some joint meetings of boards and commissions, and that's been happening. What we now have in place in the State is a draft standard for redesign—not redesign, but draft standards for elementary and secondary education. I would hope that when they come out this spring with the public hearings in a month or so that we're going to see an increase of interest in changing those to be stronger than what they have been. They were drafted 2 years ago.

Representative BROWN. Who drafted them?

Mr. ELFNER. The State board of education; actually, by the advisory committee. And then, that will go finally to the State board of education for approval. But, they've been under revision for about 2 years now. The political and economic climates changed rather significantly in the last 2 years. And just recently Ohio State University is attempting to establish stronger requirements for letting students into their university. I think you'll find that there are going to be even stronger standards coming out, I hope so, that what was drafted before was really not up to the expectations that we expect in any way.

Representative BROWN. Mr. Kegerreis, do you want to comment on that?

Mr. KEGERREIS. The publicly assisted state universities have joined through the Ohio Board of Regents with the department of education to encourage the reintroduction of college bound standards for the Ohio schools. The combination of preaccess to Ohio's publicly assisted universities by any Ohio graduate of a high school has been—has put a burden on the universities for providing facilities to each Ohio school courses that were missed by some of those students on their way to the universities. And it's a burden in the private sector of higher education also. We're trying to reintroduce some of those college bound standards that used to be a very commonplace requirement in high schools for the so-called preparatory course.

Representative BROWN. Does the financing system of the State universities put the same advantage on a student who must be given remedial reading or English as it does on a Ph. D. in chemistry?

Mr. KEGERREIS. Well, not quite. We have a complicated subsidy system, but if a course is being taught that is not giving credit for the degree which the student is seeking, then the subsidy doesn't apply. So, there is a differential standard. And the result is that we have relied on Federal outright subsidies and State subsidies for that remedial system.

Representative BROWN. Does the undergraduate in chemistry get the same count as a doctorate in chemistry?

Mr. KEGERREIS. Oh, no. There are 16 different levels of subsidy. It's quite complicated.

But, to turn quickly, I know time is running short, one way to encourage interest in science is to provide funding for the existing program of Ohio scholars, which is a system in which outstanding high school students are recognized across the State of Ohio. And the other is to provide reintroducing an idea of the Ohio Board of Regents, professorships in private and public universities. That would be a start. In North Carolina, to use that example again of that board that operates across the States for both public and private, they established an experimental high school, a residential high school for their outstanding science students. And they took 150 students in their first year into this new high school, and in that first year they produced the second highest number of national merit scholars of any high school in the country in 1 year.

Representative BROWN. Brother Fitz; comments?

Brother FITZ. I would say that by and large the private, independent sector of higher education has not been forced to face the issue in quite as stark terms as the State supported sector of higher education. In most cases we're able to have a set of entrance requirements that we have been able to ask students to make. For example, for the school of engineering, about 85 percent of those students are in the top 25 percent of their class. But then, there you begin to see that the quality of science education, although very good for some students, has begun to erode in the State, and I do think that in the basic skills that prepare students for a college education, both the private sector of secondary education and the public sector is seriously deteriorating.

Representative BROWN. I'd like to pursue that. I'd like to pursue another subject different than the one we have given you, because it springs from some of the things we've been discussing. But, I think I'd like to ask if you would submit something in the way of a report, and that is, that Mr. Heine made some comments in his testimony about business incubators being created with the cooperation of Dayton University, and I think with Wright State University, too. I'd like to know how the universities view their role as participants in such incubation of new small business, with reference to other things than just the scientific area, the question of county assistance, business management assistance, and so forth. It seems to me that that ties in, as I believe Mr. Krug discussed in his testimony, to the beginning of a new business. Scientifically oriented business still has to have account-

ing procedures and tax law information and so forth that universities can sometimes provide through their other academic resources. So, if you could give us some information on that. I won't ask you to testify on that matter, because I know you have not done so in the past. One of the studies that has been available to me in background for this hearing indicates that for Ohio State University, of the doctors of various scientific pursuits, only 25 percent remain in Ohio and 34 percent remain in the Midwest. And I'd like to ask if any of you have any resources or current data on whether that is currently true, and any feeling about why it is true, whether it's the nature of the business and economic history of our area that the scientists don't remain here, or whether it's related to some other factors. If you don't have the data, if you ever develop it, I'd be appreciative of receiving it. Any comments?

Mr. KEGERREIS. I think it's already mentioned that the Ohio Academy of Science doesn't know what happens, and neither do we. But, it is true——

Representative BROWN. I think this information comes from alumni records of Ohio State University, and I don't know whether that might be available to you.

Mr. KEGERREIS. It's very unusual to have that much knowledge about the first or second destinations of your departing graduate. But, what that does not show is the number of Ohioans who go elsewhere to get their doctorates, and then come back. In terms of college students in general, Ohio is almost in balance. As many people that proportionately get their education out of the State as out of Staters get their education in Ohio.

Representative BROWN. That's also true in the science and engineering fields?

Mr. KEGERREIS. I'm not sure.

Representative BROWN. Well, any information that you might have I think will contribute to the sum of the substance of this hearing.

Finally, Mr. Elfner, I have one suggestion, and that perhaps is that there be a qualification for members of the State board of education with reference to their own training in science.

Mr. ELFNER. There's one engineer on the State board.

Representative BROWN. I would say that's a relatively high percentage as compared to this Congress where you can count all of the people who have scientific and engineering and professional backgrounds you can count on the fingers of one hand, and then even if you've had a major industrial accident.

I thank you gentlemen for your testimony, and will look forward to some other information from you in the future.

Our next panel is Mr. George Peterson of the Air Force Wright Aeronautical Laboratories; James Prather of U.S. Army Research, Development, Testing, and Engineering; and Mr. Robert Kerr from Winters National Bank & Trust Co., here in Dayton.

The purpose of this panel is to discuss military research and development and procurement, that is, procurement of research and development activities, and also the products that flow from it. And Mr. Kerr is with us to discuss the financing of entrepreneurs, venture cap-

ital, which is similar to what we have already gotten into in some degree.

Gentlemen, we welcome you to the panel, and I guess we'll start with you, Mr. Peterson.

STATEMENT OF GEORGE P. PETERSON, DIRECTOR, MATERIALS LABORATORY, AIR FORCE WRIGHT AERONAUTICAL LABORATORIES, AIR FORCE SYSTEMS COMMAND

Mr. PETERSON. Congressman Brown, the Dayton area has traditionally been richly endowed with innovators of world prominence such as the Wright Brothers, Eugene Kettering, and John H. Patterson. We, at the Air Force Wright Aeronautical Laboratories [AFWAL], are proud to be a part of that tradition.

Established in July 1975, AFWAL is comprised of four technological units; namely, the Aero Propulsion Laboratory, the Avionics Laboratory, the Flight Dynamics Laboratory, and the Materials Laboratory. These laboratories, which trace their antecedents to research elements that existed under the direction of the Army Signal Corps at McCook Field, Dayton, Ohio, as early as 1917, conduct and support the full spectrum of technological pursuits from basic research through development to technology flight demonstrators and manufacturing methods efforts. As our laboratories' names suggest, we are active in airbreathing propulsion and aerospace power; in materials including metallics, nonmetallics, ceramics, and electromagnetics; in manufacturing processes; in airborne electronics devices for navigation, flight and weaponry control and space applications; and in such flight vehicle technologies as structures and aerodynamics.

Although our major mission is to develop and expand the technology base, we are also responsible for providing technical expertise and assistance throughout the Air Force to support the acquisition of new systems and the resolution of developmental and operational problems. To accomplish this, we rely heavily upon the Dayton community and convey our needs, both current and future, through locally held technology and program reviews and seminars, of which there were over two dozen in 1981. Additionally, we house one of three Air Force information for industry offices which not only offers details as to our goals but also offers helpful information on the submission of unsolicited proposals and on opportunities for small business.

AFWAL works closely with local industry and academia in a number of ways. AFWAL R. & D. contracts with local industry and research organizations provided $12.7 million in fiscal year 1981 and now, less than halfway through fiscal year 1982, with $8.2 million. R. & D. contracts with the University of Dayton Research Institute, Wright State University, and Central State University involved $7.4 million in fiscal year 1981 and $6.6 million thus far this year. Using University of Dayton as an example, it is our observation that their willingness to develop technology centers in only a few areas and nurture them to outstanding quality and competence before expanding to other areas, may be the basis for their success. [Systems Research Laboratories, whom AFWAL funded to the extent of $7.8 million in fiscal year 1981, seemingly employed a similar approach.]

Our links with local universities provide a number of payoffs for everyone. In any given school quarter, between two and three dozen of our scientists and engineers will be found teaching as part-time instructors while over 120 of our people will be attending as part-time students. Our engineer/scientist new hires—former co-ops and college recruits—for fiscal year 1981 total 46, of which 26 were from local universities—9 co-ops, 17 recruits. Our hiring of technicians is largely limited to those from Sinclair and Clark Tech, two and five respectively in fiscal year 1981. We see ourselves as catalysts, working in concert with local industry and academia to effect a synergy in the high-technology area. We help train students for industry and our own organization. Local universities and industry develop technology centers which become centers of excellence, centers which attract Government R. & D. funding from AFWAL and others—the total AFSC Laboratories' funding in the Dayton area is about double that of the AFWAL funding alone—and produces outputs in the forms of improved military capabilities and ideas for further improvement. In turn, the national technological community has come to recognize the stimulating events which are taking place here and we then witness Dayton as the site for such national meetings as the AIAA Aircraft Systems and Technology meeting held here last August and the National Aerospace Electronics Conference [Naecon] meeting held here every year.

What more can be done? We are excited about the forthcoming Dayton Research Institute, an initiative growing out of cooperation between local industry and academia. We know this will attract more competent people to this area, potentially improve the quality of our own technical staff, and provide new ideas and approaches to meet Air Force needs. We see the new institute as contributing to our area's synergy and the Dayton area becoming more competitive for our dollars and those of other DOD and Government agencies who, like AFWAL, seek the best ideas and the best minds to insure that each and every contract awarded reflects the best buy for your and my tax dollars. Thank you.

Representative BROWN. Thank you, Mr. Peterson.

I neglected to introduce these gentlemen as they should have been introduced. Mr. Prather is the Deputy for Science and Technology Office of the Assistant Secretary of the Army for Research, Development, and Acquisition. We'll hear from him now.

STATEMENT OF JAMES G. PRATHER, DEPUTY FOR SCIENCE AND TECHNOLOGY, OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY (RESEARCH, DEVELOPMENT, AND ACQUISITION)

Mr. PRATHER. Congressman Brown, as you said, I am the Deputy for Science and Technology to the Assistant Secretary of the Army for Research, Development, and Acquisition. It gives me great pleasure to be here and be allowed to summarize the statement that Assistant Secretary J. Sculley would have presented in person today had he not been required to be in Washington. Secretary Sculley was most anxious to testify before this subcommittee, Congressman Brown, because he's very interested in promoting a better understanding in the public at

large of the benefits to trade, productivity, and economic growth of what is usually referred to as military R. & D. He has pursued careers in both military and academia, and these experiences have made him especially sensitive to the critical role of DOD sponsored university based research and development.

The Army's R. & D. budget is currently more than three-quarters of a billion dollars. That's the categories we considered 6.1 and 6.2. Almost half of that amount is actually spent outside the Army Establishment. That is more than $300 million of Army research and development that is actually performed by universities, private industry, large and small, and nonprofit institutions. Mr. Sculley's statement concentrates upon the four channels by which outside Army R. & D. funds are currently disbursed. It is the firm intention of Mr. Sculley, also reinforced by the Under Secretary of the Army, James Ambrose, that these channels ought to be widened and deepened. Although policy guidance comes from the Assistant Secretary of the Army for research and development in that position, the civilian side of the Army R. & D. funds are actually administered by the Deputy Chief of Staff for Research and Development and Acquisition, the green suit side of the Army. Mr. Frank Verderame, Director of Research in the Office of the Deputy Chief of Staff for Research and Development and Acquisition is with me here today, and I will have to defer to him any questions you may have on specific administration of Army R. & D. funds. And he also will be available for anyone who wishes to contact him in some of the other hats he wears that I'll mention later on here.

Also with me is Maj. Fred Strobel of our Army Congressional Liaison Office, sitting here on the corner at the first table, who will follow up any questions you may have, Congressman, which we're unable to answer today.

Now, for the four channels. First, the Army in-house laboratories. Depending on how you count them, there are at least 30. And this document here, which I'll mention in a minute, lists 53 laboratories operated by the Army and staffed with Army miltiary and civilian personnel. Most outside Army R. & D. funds are administered through these laboratories. The Department of Defense encourages unsolicited proposals to be submitted directly to these laboratories. With me is the Department of Defense publishing brochure, which I hold in my hand, and of which there are copies available back at the table near the door. We publish a brochure entitled "Department of Defense In-House R. & D. T. & E. Activities." It describes each of the DOD laboratories, the ongoing activities at each laboratory, future areas of interest, and it lists point of contact. Mr. Verderame, whom I just introduced a moment ago, is the individual who should be initially contacted with respect to any Army laboratories.

The second channel is the Army Research Office. The Army has a special laboratory called the Army Research Office located in the Research Triangle Park in North Carolina. ARO exists primarily to find outside Army R. & D., especially at universities and nonprofit institutions. ARO published a program guide, which I hold in my hand, and there are copies available at the table by the door, which outlines the current ARO interests. It also lists specific contacts in specific areas of interests. Categories of interests funded by the Army

Research Office are biosciences, chemistry, electronics, engineering sciences, geosciences, mathematics, metallurgy and material, and physics. Mr. Verderame, again, is an individual to be initially contacted if it is not clear which is the appropriate contact at ARO that's listed in this document.

The third channel is the advanced concepts team or ACT. ACT serves to receive and quickly evaluate and fund any imaginative new concepts which have potential for significant near-term payoffs, particularly those proposals not closely identified with ongoing Army R. & D. programs, and those proposals coming from nontraditional sources such as Congress, the White House, Office of the Secretary of Defense, et cetera. Mr. Sculley's statement describes ACT in some detail. We don't have a pamphlet on the subject. The individual to contact within the Army is a colleague of Mr. Verderame's in the Office of Deputy Chief of Staff for Research, Development, and Acquisition. His name is Mr. Charles Church.

The fourth channel is the defense small business advanced technology program or Desat. The Desat program instituted last year seeks to promote innovative solutions to important R. & D. problems facing the Department of Defense by utilizing the capabilities of small science and technology based firms. The categories are split up among the services, the Army, the Air Force, the Navy, and the Defense Advanced Research Project Agency. The Army categories are chemical defense, combat equipment and materials, medical support, human factors and communications. Participation is encouraged into the Desat program by a simplified three-phase R. & D. contracting and procurement process. Phase 1 of this program funds feasibility studies. DOD has awarded approximately 100 contracts during the first year, each for up to $50,000. Most of them were for $49,999, as I recall. Phase 2 will allow for full scale R. & D. for those projects judged most promising in phase 1. R. & D. contracts of up to $500,000 each will be awarded in phase 2. Phase 2 of the Desat program will allow—no, phase 3 of the Desat program will allow advanced development and appropriate production. A brochure entitled "Defense Small Business Advanced Technology Program 1981–82," which I hold a copy of in my hand, but it's the only one I've got, may be obtained by writing Mr. John Stolarick at the U.S. Army Materiel Development and Readiness Command.

Those are the four main channels of outside R. & D. funding, Congressman Brown. Responsible members of the present Army Secretary are committed to widening and deepening these channels. It is in the best interests of the Army and the Nation that a robust system of associations be maintained and developed with the academic, scientific, and small business community. We invite anyone with a serious proposal to participate.

I appreciate this opportunity to speak to you on behalf of the Assistant Secretary about how communities can initiate business with the Army.

[The prepared statement of Mr. Prather follows:]

Prepared Statement of James G. Prather

Mr. Chairman and Members of the Subcommittee:

It is a great pleasure to appear before this committee today to testify with respect to the relationship between the Army Research, Development, Testing, and Engineering (RDTE) program and such institutions as university consortiums, small businesses, entrepreneurs, and non-profit institutions.

The tradition of research between the Army and universities, the Army and non-profit institutes, and between the Army and industrial organizations is almost as old as the United States Government itself. This tradition began with the establishment of the first engineering school in the United States - the US Military Academy at West Point (1802) - and one of the first scientific expeditions - that of Lewis and Clark (1805). These histor' starts have been followed by many highly important developments including the invention of the world's first computers, ENIAC and EDVAC in 1943, sponsored by the Army at the University of Pennsylvania. The Army continues to reap great benefit from productive interaction between contract researchers and our laboratory personnel. Through such interaction the Army can obtain novel solutions to specific problems facing the Army and expert consultation on specific problems which may confront us in the future. We can share special high cost research equipment and conduct cooperative research and development programs. Through such cooperation we may tap the knowledge of a broad range of American scientists and engineers in order to better define and solve problems and maintain our technological edge.

Some recent examples of accomplishments achieved under Army contracts include the following topics which have had a high payoff in terms of increasing our capabilities:

- o Rapid diagnostic methods for chemical warfare agent exposure;
- o Quantified measurements of visual acuity in pilots;
- o New uncooled thermal imaging concepts for night vision;
- o New design methods for integrated circuits by X-rays and electron beams;
- o New high strength metal alloys;
- o Energy utilization predictive models for designing buildings which conserve energy.

Next, I would like to tell you briefly about the Army's current technology programs and then provide the Committee and interested members of the audience with a simple primer on how to go about contacting the most appropriate Army office for submitting research and development ideas. The Army's mainstream technology base spans a wide variety of subjects including combat vehicles, engines, armor, munitions design, small arms and ammunition, computers and software, lasers, radar, photography, camouflage, electric power, missile guidance and control, fuels and lubricants, food and clothing, chemical and biological warfare protection, medical research including disease prevention and burn treatment, helicopter design, buildings, fortifications, training and artificial intelligence. Present thrusts are in areas which will produce new "smart" guided munitions; new communications; command and control systems; new ways to match fighting vehicles to their operators; and biotechnology. These thrusts and the research and development necessary to achieve these new capabilities will receive much attention and financial support during the next five years.

Next I would like to tell you about how research and development funds are apportioned within the Army.

Under guidance policies set by the Office of the Assistant Secretary of the Army for Research, Development and Acquisition in cooperation with the Army's Chief of Staff, funds are administered by the Office of the Deputy Chief of Staff for Research, Development and Acquisition. The funds are channeled to the Materiel Development and Readiness Command, the Office of The Surgeon General, the Office of the Chief of Engineers, and the laboratories of the Deputy Chief of Staff for Personnel. The funds are then channeled to the laboratories and the Army Research Office.

Now as I promised I would like to tell the Committee and the audience how to tap those funds by submitting ideas for promising research and development to the Army through the Army Research Office, the laboratories themselves, through the Advanced Concepts and Technology (ACT) Committee in the Pentagon, and the Defense Small Business Advanced Technology (DESAT) Program.

The Army Research Office, Research Triangle Park, North Carolina 27709, publishes a document entitled "Program Guide" (25 copies supplied) which gives an outline of their current research and development interests. As a first step, it is recommended that the first contact be made with Dr. Herman Robl or Colonel Duff Manges, telephone 919-549-0641, or by letter outlining the kind of work to be proposed. This preliminary contact will often lead to the second step - a request for a two or three page letter describing the proposed research. This will be used to judge whether there is sufficient basis for proceeding with a request for a full proposal and a formal technical review.

For the formal review, the Army Research Office staff relies heavily on the advice of scientists and engineers outside of its organization in arriving at contract selections. The two most important criteria are scientific merit and

relevancy to Army interests. Typically three to five Army laboratory scientists or engineers plus three to five peer reviewers comment on proposals in the formal technical review. The final judgment, however, is in the hands of the Army Research Office program officers who have corporate memory of scientific priority and military technology, program balance, and budget resource information at hand.

In order to contact the laboratories directly, we supply a brochure entitled "Department of Defense In-House RDT&E Activities." This document may be obtained by writing Headquarters, Department of the Army, Attention: DAMA-ARZ-D, Washington, DC 20310 (five copies supplied). It describes the activities and interests of all of the Department of Defense laboratories and the names and addresses of key individuals who may be contacted in order to elicit interest in proposed research and development. All of the Army laboratories are included in this brochure. For preliminary information and guidance into the activities of the laboratories, those interested should call Dr. Frank Verderame, Assistant Director of Army Research, telephone 202-697-3558.

In 1974, senior managers of Department of the Army research recognized a growing need to shorten the long funding and budgeting process for new, innovative, high risk type ideas and concepts. Consequently, the Advanced Concepts Team was formed to act as a central point to receive, quickly evaluate, and fund imaginative new concepts with the potential for significant near-term payoffs which would increase the Army's combat effectiveness. The ACT was not intended by bypass the traditional channels and procedures for ideas that offered more modest improvement potentials. ACT has always been very cautious about initiation of efforts which are more properly identified

as R&D Command initiatives. ACT has attempted to maintain its role of initial funding of high payoff areas with an early hand-off as mainstream programs to the R&D commands. ACT has continually passed the management of programs it supports to the development activity that would be responsible for the item in later stages of development and acquisition.

ACT's mission in the research and development process is to serve as an Army initial point of entry as well as a court of last resort for new concepts and new applications of old concepts. ACT has an active interface with industry. In this way, industry is made aware of the Army's long range plans and objectives. In many cases, ACT is the only way unsolicited proposals from the private sector receive high level identification and start-up by being brought to the attention of Department of the Army level personnel. This ensures compatibility of research efforts with the Army's long range plans and objectives.

A major role of the ACT Committee is to ensure that Army R&D does not overlook good ideas that could improve the combat effectiveness of the Army. Other roles are the early identification of new technologies, and the support of those technologies that do not have a clear home in the R&D process, affect many development activities, or do not have a single proponent. ACT's operations have established lines of communication between people with good ideas for the Army and those Army laboratories which can help get them adopted to Army missions. The ACT Committee, whose membership consists of high level personnel having a broad knowledge of the Army's problems and the ongoing research toward their solutions, has been able to establish a dialogue between the proposers and the appropriate laboratories. The ACT is, to some degree, a

clearing house for new ideas, a role that has been warmly received by the private sector seeking to do business with the Army.

ACT has been very successful in its original role. It has been a major factor in the early identification and support of technologies so necessary for the future of the Army. ACT also provides a method to evaluate concepts coming to the Army from sources such as the White House, Congress, Office of the Secretary of Defense, and various Army Staff Agencies. ACT has gained credibility as an impartial and fair means to assess those concepts and answer the critical inquiries in a timely manner. When proposals are received and the Memorandums of Understanding executed, the proposals undergo an initial screening. The proposals are then sent to the appropriate laboratories and/or users for evaluation. If technical feasibility and user need is indicated, the proposer is invited to present an information briefing at their own expense. Finally, the proposals, evaluations and briefing material are reviewed by the ACT Committee and a decision is reached relative to award of a contract. A minimum of five ACT Committee members must be in agreement before a final decision is made.

The Army's ACT Committee will evaluate any idea for Army interest on a quick reaction basis. The ACT Committee was set up by my predecessors in 1974 for the timely evaluation of new concepts and new applications of concepts. This Committee is authorized to fund high potential payoff concepts and "proof of principle" experimentation and to expedite implementation of new ideas from industry and academia. Initial contact with the ACT Committee may be made by calling Dr. Charles E. Church, 202-695-3718, or by writing to Dr. Church at Headquarters, Department of the Army, Attention: DAMA-ARZ-E, Washington, DC 20310, to request instructions on how to submit proposals.

The Department of Defense encourages small business firms which have strong research and development capabilities and experience in high technology science or engineering to submit proposals to the Department of the Army, Navy, Air Force, and the Defense Advanced Research Projects Agency (DARPA) under the Defense Small Business Advanced Technology (DESAT) Program.

This program, instituted last year, seeks to promote innovative solutions to important scientific and technical problems facing the defense community by utilizing the resources of small science and technology-based firms in Department of Defense research and development. Participation is encouraged by a simplified, three phase research and development procurement process. Phase I of this program will support feasibility-related experimental or theoretical research and development effort on a proposed idea or approach to a scientific or technical need. The Department of Defense anticipates awarding approximately 100 contracts for up to $50,000 each for feasibility research and development over a period of performance not to exceed six months. Phase II is designed to allow for full-scale research and development of suggested approaches which have been judged most promising. Research and development contracts of up to $500,000 each will be awarded in Phase II, contingent upon favorable evaluation of a first phase report and a Phase II proposal. Phase III of the program will include follow-on development of the project when necessary, or production where appropriate.

Recognizing that small business has an established record for innovation, the Department of Defense is interested in increasing the participation of this important national resource in Department of Defense research and development to meet National defense needs. Innovative research and development by small

business firms can make significant contributions to this Nation's defense through the solution of important problems or the exploitation of new opportunities. In turn, the Department of Defense supported research and development may provide a small business concern with the basis for new potential products, processes, and services. A brochure entitled "Defense Small Business Advanced Technology Program 1981-1982" may be obtained from Mr. John Stolarik at the US Army Materiel Development and Readiness Command, 5001 Eisenhower Avenue, Alexandria, Virginia 22333, telephone 703-274-9559. This brochure describes the Services' interests and procedures for submitting proposals.

In addition to funds for research and development provided through the several channels which I have outlined, I should mention several other cooperative programs sponsored by the Army to support research associateships, faculty summer programs, research at Historically Black Colleges, and support for providing hands-on-research experience to high schoolers at the Army or contractor laboratories. Further information about these important cooperative programs can be obtained by calling or writing Dr. Verderame.

Mr. Chairman and members of the Committee, the Department of the Army has good reason to foster a robust system of contracts with the scientific, technological and business communities, and we invite anyone with a serious proposal to participate. I sincerely appreciate this opportunity to speak to you about how this community can initiate business with responsible Army officers.

Are there any questions?

Representative BROWN. Mr. Prather, thank you very much.
Our final panelist is of the Winters National Bank, Mr. Robert Kerr.

STATEMENT OF ROBERT KERR, CHAIRMAN, WINTERS NATIONAL BANK

Mr. KERR. I apologize for not having a prepared statement, Congressman Brown. I did cancel, accept and then cancel, and then reaccepted. And I can only blame that on the rather stormy economy that you alluded to at the beginning of this program.

I am chairman of the Winters National Bank, including the Winters National Corp. Winters National Bank is the leading local financing institution in the Army. And Winters National Corp., is an Ohio bank holding company with banks in Cleveland, Circleville, Dayton, and Cincinnati, with 1,700 employees in the State, and assets in excess of $1.6 billion.

I've had the good fortune to have been in the banking business for 35 years, and somewhat less than that as a very active banker in the Wall Street division of the Irving Trust Cos., and as such banked the startup of many small electronic and other high technology firms. And I also worked in the development of many others. These would include Litton Industries, Bunker Reynolds Corp., Barnes Engineering, Pierpont Laboratories, LSI, which used to be Seiler Corp., Syntex, Hughes Aircraft Co. And since being in Dayton in the last 14 years, this August, I think we have banked more than a majority of the local high technology firms that have started since then.

You've heard a large group of people talking about high technology and how it can best be fostered and permitted to grow in the Dayton area. I for one have been very interested in hearing all of this. I have been close to the local leadership and have been aware of how effective it has been, at least with that part of the development and the growth of high technology companies that they can control, that are within their control. I'm reminded of the fact that over 10 years ago Dean Graney of the University of Dayton Engineering School, dean of that school, prepared an important analysis of the strengths and weaknesses of the Dayton area as they at that time related to the fostering of high technology companies. Perhaps the only major necessary resource, from my standpoint, and lacking in, is the existence of an important research library. The combined libraries of Duke University, North Carolina and North Carolina State can make up one of the more important research library combinations in the country. And there seems to be a direct correlation between the existence of a first-class research library and the existence of new and growing high technology firms. The library in Dallas last year, I'm told, had over 2 million inquiries from business and industry.

I might say that the partnership and coordination of industry backing from universities and local government has been a powerful and mutually reinforcing force in the developing of our community, not only in this subject we're discussing today, but in many others.

There were some specific questions that I'd like to deal with that were in the letter that you sent to me, and I'd like to deal with those quickly, and then go on to what I have to say. It's said that it's better

to light a candle than to curse the darkness. Many candles have been lit here this morning, and I think I'll curse the darkness a little bit when I'm finished with this. What are venture capital markets, and are they adequate in Dayton? They are adequate in Dayton. There is plenty of venture capital in Dayton. There is more venture capital in Dayton than there are ventures to capitalize it seems. And one of the reasons is the fact that a venture capital dollar is a 100-cent dollar. The type of dollars that Mr. McSwiney was talking about in the development of their opportunities in the Mead Corp. are soft dollars. They're pretax dollars, and they're 54-cent dollars. So, the venture capital dollar starts out at a disadvantage right in the beginning over the soft dollar. So, the venture capital dollar perhaps is a little more conservatively invested than the potential recipients would like to see it be. But, there is plenty of venture capital in Dayton and in the State of Ohio and in the United States.

There are major business magazine. Our major business magazines are writing lead articles on all of the venture capital that is available. It is the hot thing to do.

Second, do Ohio banking laws discourage banks from financing startup companies? The answer is no. As a matter of fact, we work very closely with the SBA, and have made many SBA loans. One of the more recent ones was the financing of the start up of the new Shopsmith Corp. here.

What can the business community do to provide the necessary capital for high technology and related companies? What they can do first is to see to it that there is enough venture capital. There was a venture capital firm mentioned here earlier today, and we're pleased to be the largest shareholder in that firm.

Does Ohio banking need reform? No. To what extent does the holding company have to encourage banks like Winters to participate in venture capital financing? We believe the worst people in the world to get into venture capital are commercial bankers. And we're trained to think in 90-day cycles and not in larger term cycles. One of my dear old friends and good customers many years ago, Pat Hyland, L. A. Hyland, who was head of Hughes Aircraft, said, "As a matter of fact, the worst person in the world to put in charge of a high technology company is a businessman, because he's forced to think in 1-year cycles." As he said, "He's forced to kneel at the altar of the Byzantine calendar," whereas the research people that he was in charge of were being paid to think in terms of decades.

Now, what can be done outside of the local influence on the development of high technology companies? The questions that I just answered are largely local questions. They have been and are addressed and dealt with locally. The larger questions deal with national policy. It's a very scratchy record right now. Unfortunately, the latest figures on the cost-of-living index has shown an annual inflation increase of 6.3 percent. But, probably the worst disaster that has happened to small companies, their origin, their development and their growth in the past 5 or 6 years has been the rate of inflation. It's created false profits on which taxes have had to be paid. Before the Tax Recovery Act of 1982, the depreciation schedules were completely inadequate with the replacement of equipment. It

largely destroyed the equipment use of small companies, including those companies in the high technology area. Of the companies in trouble today, the major ones, of course, get the headlines. But, the smaller fellows, believe me, are having a very difficult time to survive. With the present prime rate at 16½ percent, all you can say is that it's better than it was at 20½ percent. I really wonder whether Washington has really wanted—this is an exception, the exception view, Congressman Brown. I'm talking about Washington, that wonderful island.

Representative BROWN. I live in Urbana.

Mr. KERR. Has Washington really wanted to create an economic climate conducive to the birth and growth of small companies, including high technology companies? From the broad pronouncements that we see emanating from the Nation's Capitol, one might think the answer to this is yes. It seems to be one of the political in things to say, "We want to do everything we can to help small companies." But, the substance and the facts would indicate otherwise. As an example, the substantial increase and change in the nature of the capital gains tax over the last 10 years has tampered with the risk-reward ratios of starting small high technology companies. And this has been destructive. Happily, the Tax Reform Act of 1981 has partially addressed this. But, whenever, as a banker, whenever I watch risk-reward ratios being tampered with, something bad happens. With the new explosion and new technology available, in my opinion one of the reasons why we don't see the massive formation of new small high technology companies now that we saw in the 1950's and 1960's is this capital gains tax. The venture capitalists creates the fuel for the small company, but someone must start it, run it, take the risk of failure. And if the reward isn't big enough to overcome that risk of failure, it's much easier, believe me, to work for a larger company and bring home a salary that you at least can count on week after week.

In addition, many other sections of the Tax Code offer disincentives. I don't think there should be any income tax on the early profits up to a predetermined amount of a new enterprise, that is, profits that are not distributed but kept in the company. Those first years, as I'm sure Maury can remember, are the high risk years when the company is struggling to develop stability. And the minute it starts to make money, half of it goes away. And even more particularly during periods of inflation, with a restrictive tax policy, it is very tough for these companies to survive. Mr. McSwiney alluded to the tax handling of basic research expense. Basic research is against what I call development expenditures. I've heard it described as applied research here today. But, I think the entire tax handling of that basic research should be reviewed with the objective of encouraging it. It needs to be encouraged. And it needs to be encouraged with the smaller companies, because I think they're the most creative. They have the most to gain, and because they're so thinly capitalized, they have the least to lose.

When in the Carter administration and then Secretary of Transportation, Brock Adams asked Detroit to reinvent the automobile, he was asking the wrong people. Large companies have difficulty making large and new and creative undertakings that would tend to make

obsolete or obsolescent a good part of what they have. This is not true with the small companies. They can move much more rapidly. So, I think that the tax handling of that basic research done by small companies should be reviewed to encourage it. And I think that all legislation should review it as to its impact on small business.

A bank has a trust division. A trust division, among other things, handles pension funds. Once a month with our board we show them all the new accounts opened and the pension funds closed. The first 2 years after the legislation that gave birth to ERISA, they were closing by the dozens, and all the ones that closed were the small companies. They couldn't understand the legislation, but the penalties outlined came out very clearly. So, again, they felt they were taking too much of a risk for that reward. I would also guess that tens of thousands of small company plans succumbed to that act. And the act is a good act. I think it's being poorly administered. The web of regulations laid over a small company today is amazing, and it's counterproductive.

We see this—forgetting high technology companies for a moment, but we see this among smaller banks. They can't afford to hire the people that are necessary to cover all of the bases involved with truth-in-lending, truth and everything else we have to work with. Our bank alone in just satisfying the Department of Labor and Treasury Department, as far as our personnel is concerned, pays about $300,000 a year. We find it difficult to pay that, but we can do it. But, the small company, the small bank can't. And the small company, the small high technology company, finds it very difficult to cope with, and many prospective entrepreneurs, as a result in my opinion, throw in the towel too early. This type of legislation, and I feel safe in saying this also, Congressman, this type of legislation and regulation, probably is the reason why we as a nation graduate far more lawyers than scientists and engineers. Thank you.

Representative BROWN. A man after my own heart by attacking lawyers.

Gentlemen, I thank you for your testimony, and it has been very stimulating. I want to highlight one item of Mr. Peterson's statement: you had this line in your statement. Using the University of Dayton as an example, it is your observation that their willingness to develop technology centers in only a few areas and nurture them to outstanding quality and competence, before expanding to other areas, may be the basis for their success. That seems to suggest that for acquisition of research and technology, and others, I guess, even maybe products, that there is a judgment based on the quality and competence as opposed to the low bid or some other determination when it comes to research work. Do you want to expand on that just for a minute?

Mr. PETERSON. Yes, if I can. It came up in Maury Krug's testimony earlier, we find at least in the technology end of the procurement business that we do have a sufficient amount of flexibility in terms of taking the best ideas and not always the low bid. Therefore, it's simply not an envelope opening ritual. You go through, you assess the proposal, you're looking for innovation, and to a great extent we find that where we dealt locally with organizations, that has tended to bring bright people in certain areas and decided to focus, so to speak, rather than to spread themselves, we find it very stimulating from our stand-

point to get high quality work locally. And I believe that that strategy is one that we have tended to, in the community, as we have worked with them locally, that we tended to sponsor and stimulate as well. So, where we see areas, emerging areas with high payoffs such as polymer science at U.D., NDI at SRL, we have tended to try to, as best we can, to recommend and advise those companies to move in those areas and to focus. And I believe that's a good way to start, to get a ball rolling.

Representative BROWN. Your comments would tend to reemphasize the point made earlier in response to questions, that it's a good idea to focus the investment of academic activities into few fields of excellence. But, isn't there a high degree of risk in guessing wrong? I mean, I've looked at the energy field with which I'm more familiar than I am with the military weapons systems field, and I think in terms of the many people who have guessed wrong in this area or at least guessed wrong in reference to the fashion of government interests.

Mr. PETERSON. If I could respond, I guess it depends on what dimension of the spectrum you're looking at. If you're looking at the basic and the applied end, the closer you get to the basic the more difficult it is in my mind to be wrong. Basics are basics in my mind.

Representative BROWN. The more difficult it is to be wrong?

Mr. PETERSON. The more difficult is to be wrong. Basics are basics. I think as you tend to get more applied and start to get into the systems end, to be wrong, you can be wrong in those areas. So, therefore, in running the materials laboratory, for example, I sit down with my corporate board internally and we tried to figure out where the materials and science technology would be 10 years from now, what are the ripe areas to explore. Now, we might be wrong some, we're not always right. We continue to reassess. But, there are certain fundamental things like polymers, for example, which I think Tom Heine mentioned in terms of nonmetallic materials replacing more materials to a great extent. We see that as a ripe opportunity. Polymetallurgy is a ripe opportunity. And those things I don't believe you can be far wrong on. And, therefore, research and development in those areas is, to a certain extent I would categorize, if not completely safe harbors, at least relatively safe harbors. And, therefore, the investment and resources in terms of people and equipment in those arenas, I think, can be looked at with a certain degree of comfort.

Representative BROWN. Let me try to relate this to one of the things that Mr. Kerr said, and that was that the large corporate enterprises are the least likely to get into dramatic research changes. Is it because they are too influenced by their marketing departments, by the people who don't want to invest the 100-cent dollar but would rather invest the 54-cent dollar in doing the same things. In other words, to make the same products cheaper and better as opposed to finding a cheaper and better product or something that is a more serviceable product?

Mr. PETERSON. I agree with what Mr. Kerr said 1,000 percent. There is absolutely no doubt. If you're looking for innovation in terms of a dramatic move forward, I'm talking not about incremental change, I'm talking about revolutionary change, the worst place to go most often is the place that currently has the established position. Therefore, we tend to look, as we looked for innovation, we tend to

look at smaller companies, companies in some degree that are outside, in many cases, completely outside the area for innovative kinds of ideas, and they do tend to come, and we find them increasingly in small houses and not in very large companies with established ways of doing things.

Representative BROWN. Your comments would seem to have a justification in the economic field, because we find that the new job creations in the United States are heavily in the small business area. Also the productivity advancements come in smaller firms to a much higher degree than in larger and established firms which carry an immense amount of overhead as Mr. Kerr suggested in his comments about accountants, lawyers, and so forth. I believe this is so because there is a tendency to be willing to innovate and to take the fringe risk. Mr. Kerr.

Mr. KERR. I want to make sure that I'm not misunderstood. In talking about creativity, particularly in the area of new technology, I think it is true and I agree and I stated that the greatest creativity is in the smaller companies. But, that doesn't mean that there's no creativity in the larger companies. When the Cincinnati Reds have a batting order that is winning 10 games in a row, you don't change the batting order. You get to be very good at what you're doing, and most of your resources and talent is dedicated to doing what you're doing even better. That is not true with a small company that is trying to find something to do. And that's where the creativity comes in.

Representative BROWN. A certain amount of inertia, however, creeps in, and it seems to me that that might also be true in the financial community, where if you're used to making your tax base and you're living out of General Motors and United States Steel and International Harvester, all those solid blue chips, that you tend to want to reinvest in those same things as an investor. So, it's a little more than the 100-cent dollar versus the 54 cent dollar. It seems to me it's a little bit of psychology that says well, they'll always be around and they're as solid as the Rock of Gilbraltar and yet, we see some of those rocks crumbling.

Mr. KERR. Well, there are many new techniques, as you know, that have cropped up. In the financing of very highly speculative high technology ventures such as genetic engineering, there are many limited partnerships of quite considerable size that have been formed in the United States for the purpose of spending that money through universities and others in genetic engineering, and that is a way of applying the research expenditures to personal tax brackets.

Representative BROWN. You didn't speak to carry forward and carry back of losses in small companies. Are those laws currently inadequate, do you think?

Mr. KERR. I think they bear looking into, Congressman. I do believe that there are other areas that are more important, particularly the area, as I mentioned, of capital gains tax, and also the area of double taxation; that is, the elder manager of a business pays himself a salary, and if he ever pays a dividend, he gets taxed twice. But, I think perhaps carry forward would be more important than carry back, because it's those first years that it's very tough to make a profit, and

you do have some losses that would be good to be able to carry forward to the extent that they're not lost.

Representative BROWN. I'm sorry that you didn't mention depreciation scheduling.

Mr. KERR. I did.

Representative BROWN. Well, I mean in this iteration, because I have a piece of legislation that would allow a new company in the first years of its life to depreciate at its own selected rate; in other words, take its depreciation all in its first year or in the fifth year depending on the depreciation life allowed in the law, which would let it lose money for a while, and then charge it all off against a loss or against a profit at the time it makes a profit. It appears it may make some sense for a small company.

Mr. KERR. I think so. And I think the Tax Recovery Act of 1981 led the recovery in that reform. It does go a long way in this connection to help smaller companies survive. As a matter of fact, I think it probably is a very powerful stimulant in spite of the fact it doesn't go all the way on the capital gains tax in the formation of venture capital firms.

Representative BROWN. A series of quick questions. I'll try to keep out my own biases here. What role does the Air Force Institute of Technology play in the development of MVRI, or are you in a position to comment on that, Mr. Peterson?

Mr. PETERSON. Well, I'm not directly involved in the Air Force Institute, although it does represent a training capability that we find in the normal laboratories as one that offers you an influx of trained qualified people while they matriculate. So, we find them a people resource asset, and I believe that in the total spectrum of MVRI that they would continue to represent that alongside of Wright State and the University of Dayton and the other educational facilities. So, we see them as a very positive source of trained people.

Representative BROWN. You heard Mr. Krug, both of you, Mr. Peterson and Mr. Prather, suggestion that procurement decisions be given advantage to firms located within 50 miles of where the procurement will be used, and that is an economic advantage, not one in law. What do you think of that suggestion? What's the local approximate percentage of procurement that goes to local firms? And has anybody in the Defense Department ever made a study of the cost of travel as it might be laid against a specific procurement?

Mr. PETERSON. I really feel the major advantage has nothing to do specifically with the dollars and cents figure that rests with travel. I think the point that I was getting at, and what Maury was saying is really the fact that the opportunity—in a close converted, cooperative kind of way, to intermingle that opportunity which, forgetting about dollars and cents, it's hard to put into a dollars and cents figure from a dollar and cents standpoint, represents a positive aspect that I believe already weighs to a great degree as you would sort between a local contractor and one that was in St. Louis or Los Angeles. And it simply says my ability to work closely or be close to the program is an ability in—there is ability in a positive aspect to anybody who can be local, and it's got nothing to do with the fact that going to St. Louis costs $300 and it's taken up, it's

simply the time. And I can climb in my car and in 30 minutes be someplace. Whereas to go to St. Louis, it takes me a week to plan the trip, and I go in there for a day, and I've got work to do when I get back here.

So, I guess it's my point, Congressman Brown, I'm probably not saying it very well, it would be difficult for me to assess that on a dollars and cents standpoint. But, there is a great deal of positive aspect to being able to work closely, and to be able to get, on a day-by-day basis, to somebody local than it is in terms of scheduling and all the things to get to Ames, Iowa, or wherever the hell it is you want to go.

Representative BROWN. Does the average procurement official make that judgment or is that a judgment that can be made by the people who actually have the relationship? I'm trying to separate now the——

Mr. PETERSON. For the most part——

Representative BROWN [continuing]. Decision process.

Mr. PETERSON. For the most part it's made, I believe, in both areas. It's made initially by the people who evaluate the program technically initially, and then by procurement people as well to a limited degree. And I would have to tell you in answer to your question, I know of no concerted study that's been made on the advantages of someone within a 50-mile radius versus sources that were further separated than that.

Representative BROWN. Well, Mr. Prather, there's an assignment for you.

Let me also ask how those channels that you mentioned being widened and deepened can be widened and deepened in the Dayton area, specifically. One of the complaints I frequently hear from small business people is that doing business with the Federal Government is like making love to a gorilla, that it can be stimulating but also pretty exhausting. To try to go after the Federal Government's procurement process with limited resources of a small business, is a good thing to avoid. Also, there is a lot of inertia in the Federal Government you have to overcome, and most small businessmen don't seem to have time for that as opposed to a larger business concern with numerous accountants, lawyers, and others.

Mr. PRATHER. Well, with respect to small business and entrepreneurs, I think the most common reaction you get from them is if they had known how difficult it would be, they never would have gotten involved in the first place. But, you also do hear that with respect to contracting with the Government. If they had known what it was going to be like, they would have never initiated the contract there also. But, I think it's just very difficult to establish and start a small business and make it go.

Representative BROWN. Now, wait a minute. I don't want to pass that point too casually, because we sort of determined this morning that some of the innovation in research and development comes from the small business field, and that it would profit the Government apparently to encourage specifically that kind of innovation. We sort of concede that well, it's always difficult in a small business to develop that relationship, we concede that maybe the small business ought to

be left off of the process, and if we do that, then we accept the fact that things will stay as they are and not give us the rapport that Mr. Peterson just made reference to.

Mr. PRATHER. Well, Congressman, in the case of the Desat program, which I mentioned, the Defense small business advanced technology program, it was recognized the contracting procurement paperwork was very onerous. That was probably one of the principal things you ought to try to alleviate. As a result, this program was set up with a very simplified contracting and procurement system which is separate in the way in which you ordinarily have to go around getting something done by the Government.

The question that you asked just prior to that one, I think there are a lot of examples where you might have thought that a lot of small businesses would grow up around a major government R. & D. facility, and it doesn't. I think it's very puzzling. There was some testimony given earlier today as to how the Federal Research Triangle in North Carolina was made successful.

There are examples, in particular I know in New Mexico where there are a number of high technology laboratories, mostly deep sea laboratories, in Los Alamos, and Sandy Land where about half the money that goes into the State goes right back out again, and a lot of it that does stay with small companies, R. & D. companies, are where they do something like, say, run an accelerator under contract, which is sort of, you know, you almost have to be there to do that.

It's very difficult, it seems to me, for a small business who provides a product who's located, let's say, in Idaho to get in the contracting business in New Mexico. But, nevertheless, there are no such companies in New Mexico who do participate in and achieve a lot of benefit from their research. The same thing appears——

Representative BROWN. It seems to be a large and mysterious process, because there was one time in the fifties when Ohio was, as I recall, in the top 10, maybe the top 5 of States obtaining Government procurement contracts, and now I think we're ranging 38th or something like that. We seem to have fallen at least in that competition, and I'm not sure what influences that. One of the things I think that does influence it is the discouragement that a lot of private companies feel with the Government procurement process in general.

Mr. PRATHER. There's one other issue that hasn't been brought up, which I'm not an expert on, but I'll hazard an opinion about it. And that is that in recent years there's not been as much direction as there probably needs to be in the industrial R. & D. area. That is, if the company has a military R. & D. contract, a certain fraction of that money is supposed to be designated for industrial R. & D. in the company itself. And the companies frequently don't know exactly how they ought to direct that research. I know the Under Secretary of the Army, Mr. Ambrose, who's very aware of that problem is directed by the Secretary to take much more interest in providing direction for what companies should do when you're out of Ohio with R. & D. money, and it seems to me that once the larger companies with industrial contracts had more direction as to what they ought to be performing research on, that would help the smaller companies who either wish to

be associated in that kind of R. & D., which is the kind of level of things they can do.

Representative BROWN. Well, I'd be happy to have you or the Secretary or anyone else in your association come up with some other specific recommendations as to how the channels can be widened and deepened from the Government's side, and also if you feel obliged or inspired from the business side. Is it desirable, for instance, for the Dayton community to host for companies outside of its community? Mr. Heine's not here, I guess, but to host procurement seminars so that somebody in Cincinnati or in Columbus or Toledo who might want to come to the Dayton community and see what would be available here in terms of acquisition so it would help the economy of Toledo and other communities in the area. We might even let it go into Indiana just to encourage the general economy in the area.

I want to go back to Mr. Kerr with a couple of specific questions that may appear to have too parochial an interest for this hearing, but I think it does relate to other communities, also. What can the State do to encourage research and development by changing its tax laws? In other words, how do the tax laws of Ohio discourage R. & D., or are there State regulations—are the State regulations as much of a problem for small business formation as the Federal regulations, which you have been discussing, and what can the State do to alter the regulatory processes to encourage new business formation or R. & D. undertakings?

Mr. KERR. Well, of course, the State is far less powerful than the central government in establishing policies or getting rid of policies that are either productive or counterproductive insofar as the creation and development and prosperity of small high technology businesses. I think that perhaps that question should be addressed more by the two university presidents that testified before, and by Mr. Huntington and Mr. Krug, who are in small businesses, because they feel the direct impact. I don't see the State government as being a major supplier of disincentives for small businesses.

Representative BROWN. Let me give you an example that occurs to me as a possibility, and you can comment on it, and that is that Ohio has an intangible property tax that makes the 100-cent dollar that goes into venture capital a 104-cent dollar, or whatever the percentage of that intangible tax is. Do you see that as a deterrent?

Mr. KERR. That's a deterrent; that's a disincentive. I think that what the State can do is to do everything within its power to make the risk-reward ratio an effective ratio, that the rewards, the potential rewards compensate for the large risks taken. But, I'm a new Buckeye, I've been here for just 14 years, and I came from a State that was so patently bad in this connection I continue to be amazed about how effective the State of Ohio is in dealing with its smaller companies. I came from the State of New York.

Representative BROWN. Industrial development bonds, as a possibility; do you see that maintaining the tax——

Mr. KERR. I think perhaps what the State of Ohio can do, and Bob Kegerreis' comments about centers of excellence, I think is germane here, but to do everything you can to help in the formation of a research park of the type that the universities and the business communities are

working toward here in Dayton, to make money, seed money available for that. I think the seed money made available for that over a decade and a half or two decades would be repaid many times over. I think that—and again, I am pleasantly surprised to have seen the money in the budget for this research park.

Representative BROWN. Back to two national areas, you mentioned pension funds which are threatened by regulations, and yet there is in much of those regulations the sort of prudent man rule reemphasized that says the pension funds must be carefully invested so as to eliminate high risk. That would seem to discourage pension fund investment in new undertakings that might by definition have a high risk of success or failure both ways: The risk being of high success or a high risk of failure.

Mr. KERR. Pension funds and foundation funds.

Representative BROWN. Should those rules be changed? It's not an easy question, I know.

Mr. KERR. I think there are other things that could be done that would be far more effective than—I hesitate to use the word "tamper," because I know the spirit in which the question was asked, but to tamper with the prudent man rule, I think that high risk and high reward are fine, but the risk is still there. And if anything is done with pension funds, it should be done with a very, very tiny, tiny percentage of the pension funds. There are, as you know, venture capital funds available for partnerships for foundations as part of their investment, for a part—for trust funds outside of the pension area, for employee benefit funds, that is profit-sharing funds and that sort of thing.

Representative BROWN. You're pointing out that there is too little going on in this field, and perhaps there ought to be some allowance made for pension funds and others to make investments in research and technology?

Mr. KERR. If it's pension funds, I think, it should be a very small percentage of the pension funds.

Representative BROWN. But, a very small percentage would be a higher percentage than is the case now.

Mr. KERR. Yes.

Representative BROWN. That would help both ways.

Mr. KERR. Right.

Representative BROWN. Many communities—and I want to summarize to the extent that I can—many communities are trying to position their economies so that they are partners in the economic growth and regeneration of the 1980's of this country. Dayton has made a commitment to high technology development in the MVRI and the other approaches that Mr. Heine outlined as representative of the broader community. Its major involvement in MVRI certainly shows that Dayton is aiming at attracting new and developing industries as opposed to having its main focus merely on retaining its existing industries. Also, the promise of high technology certainly involves jobs in an area of high unemployment. And economic growth is important to an area of economic decline.

However, the development of high technology sectors also promises human thought initiative and achievement will be nurtured and will benefit not only the community, the local area, as an economic mat-

ter, but also in ways we cannot now imagine in the cultural and quality of life area. High technology development today is hopefully aimed at finding the new Wright Brothers, the new Colonel Deeds, the new Charles Kettering, the new John Patterson for the development of a future that will be as strong as the past of this community, and not so parenthetically this State and this country.

The question of how we aim at that seems to have been answered in the testimony of several: That we aim at it through the consideration of excellence, not only excellence in the quality of our research and technology, but in the excellence of our education. To encourage those innovative ideas that have led the progress in the past, and the excellence in our focus of community leadership on addressing this problem. Many of us find it is easy to lay off on others the responsibility for achieving this. Notably, a program initiated either by the President or the Congress or by some other ephemeral group that we may think is the font of wisdom, but when it comes down to doing the job, I guess it's a community job. After all these people are interrelated in the accomplishment of these successes. There may, in fact, be a Colonel Deeds' barn somewhere in the future of this community, and its nurturing is a responsibility of all of us in government, business, the financial community, the technical community, the Federal, State, and local community. It's my hope that the testimony that we have had today will be helpful in achieving not only that nurturing, but also pointing out to others how at least this community has undertaken to address it.

We've had these hearings in other communities where the focus has been on entrepreneurship, and a real effort to put together the funding and organization of existing businesses, where other hearings have been focused on maintaining the strength and vitality of the community by feeding the infrastructure, where other communities have tried to set up programs that will rebuild declining areas in a small business way, and others where the problems of big business have been addressed. So, we hope to have in these hearings a spectrum of possibilities and examples for communities all over the country, perhaps all over the world, that want to address this problem. And certainly, Dayton's contribution has been well developed in this hearing today and the testimony we have had.

I appreciate all of you in your sometimes sharp and pointed remarks, and sometimes very eloquent remarks about this problem.

Before we close, I'd like to introduce the other two people who have been sitting here at the table with me. They are Mr. Robert Premus, economist on the Joint Economic Committee, who was formerly with the Economics Department at Wright State University, and who I stole from there about a year ago, and he has made a great contribution to the Joint Economic Committee. And Mr. Mark Policinski, who also has a State university background, having been educated at Indiana University, and has served on the Joint Economic Committee since 1975, when I became ranking Republican on the committee, and has made a continuing contribution toward these studies in other parts of the country, as well as here in Ohio.

We are delighted to have had the courtesy of Wright State University in this location, and the attention of such a large audience in

these hearings as we have had this morning. And I appreciate your patience with not only the witnesses from time to time, but also the chairman throughout the morning. Thank you very much. The subcommittee stands adjourned.

[Whereupon, at 12:35 p.m., the subcommittee adjourned, subject to the call of the Chair.]

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